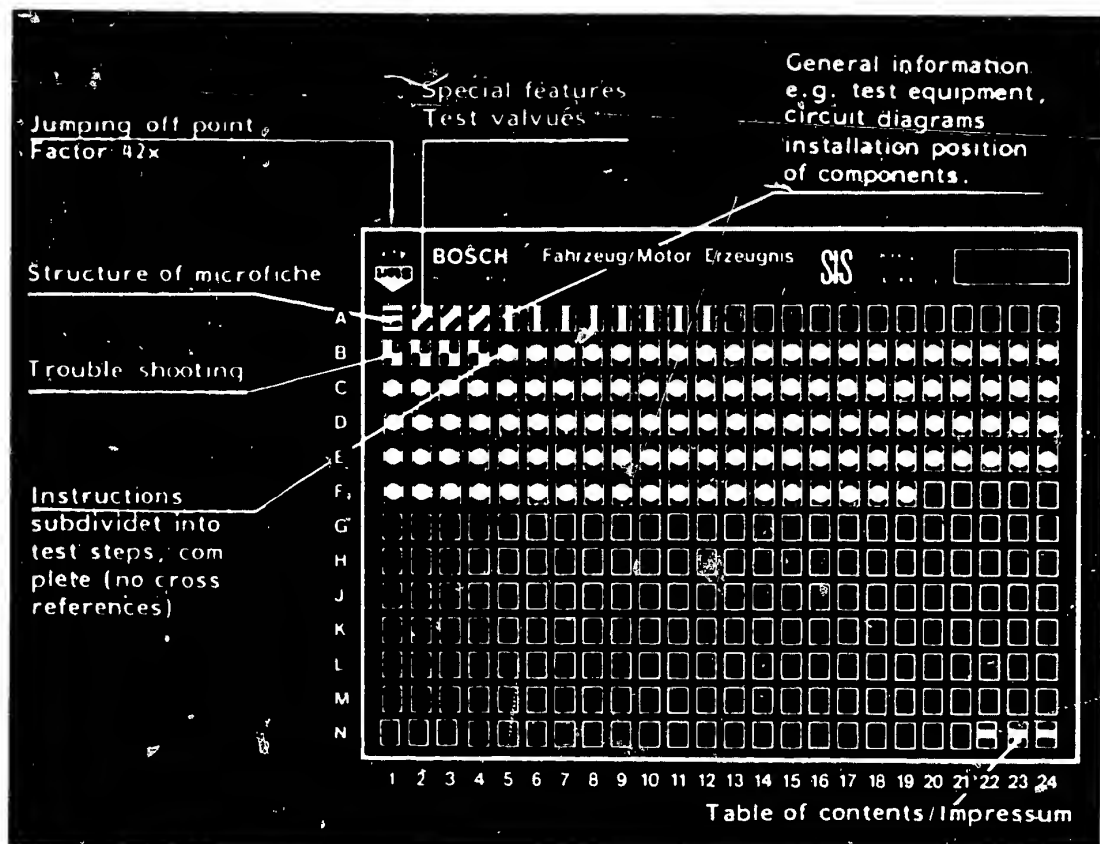


## Structure of microfiche

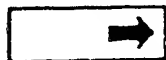


1. Read from left to right
2. Title of microfiche (appears on each coordinate)

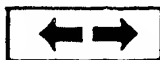
<b>E16</b>	Product/component/test step
	Vehicle/engine

Coordinate

3. Limits of section



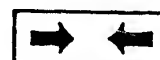
Beginning



Mid-section



End



One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6



**A1**

Trouble-shooting



## 1. Special Features

This microcard contains the trouble-shooting instructions for the Ford Transit 2.5 DI

## 2. Test specifications

2.1 Idle speed 800 - 850 min<sup>-1</sup>

### 2.2 Nozzle-opening pressure:

Opening pressure, new nozzles 250 - 258 bar

Injection pressure, used nozzles 245 - 255 bar

### 2.3 Filter test:

Max. permissible differential press. 0.3 bar

### 2.4 Compression:

Set value 33.8 bar

Permissible difference between cyl. 2.07 bar

2.5 Pressure drop max. perm. 25%

**A2**

Test specifications

Ford



## Test specifications (continued)

### 2.6 Coordination, pump - engine (injection timing):

Crankshaft position: 11° before TDC cyl. 1

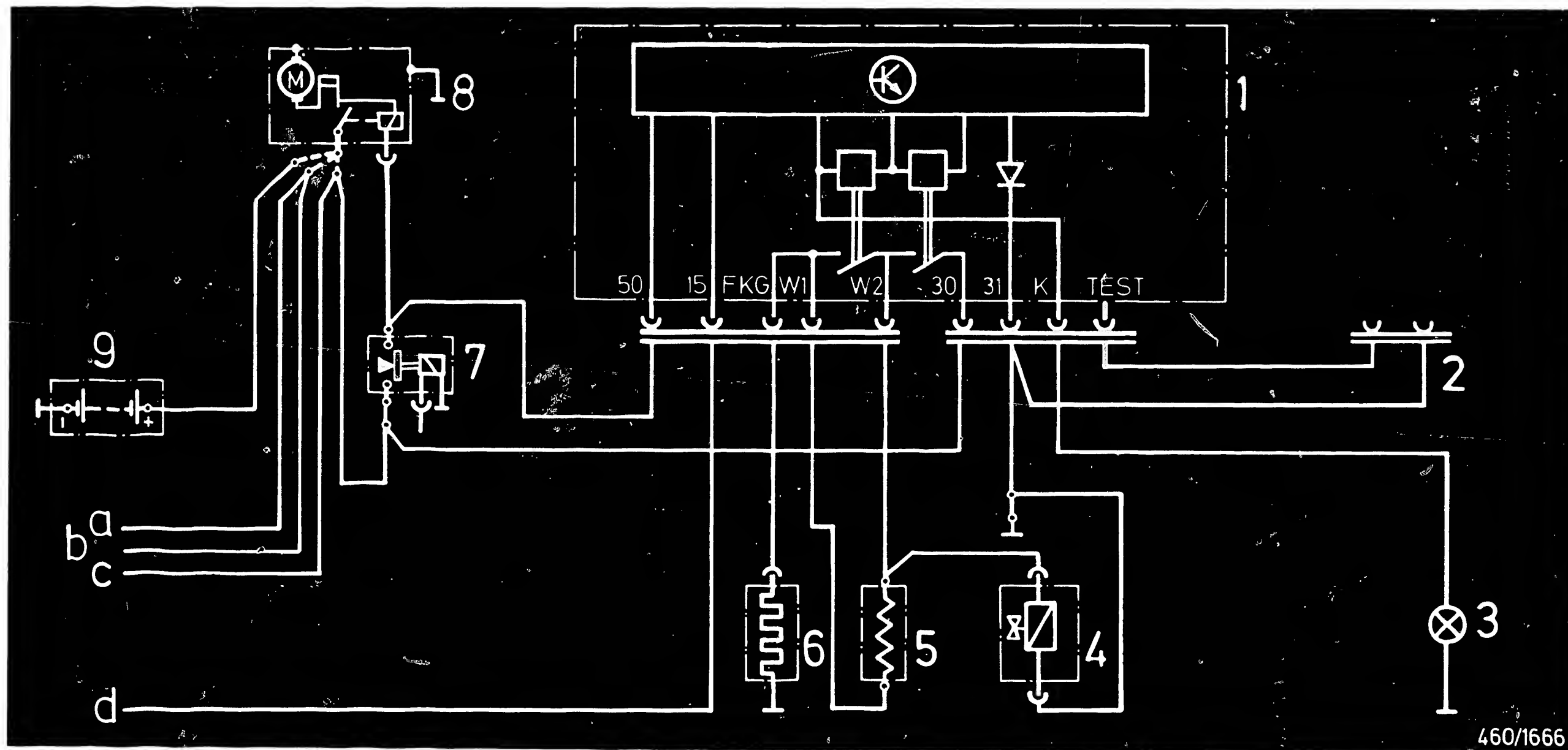
Pump position: 0.64 mm after BDC



## 2.7 Tightening torques

	Nm
Injection-pump gear	22 - 27
Belt tensioning roller	51 - 64
Clamping strap at end-face cover	20 - 25
Fastening screws of injection pump	21 - 26
Rocker-arm shaft	
M 6 screws	11 - 14
M 8 screws	26 - 32
M 10 screws	63 - 69
Fuel lines	18 - 20
Fastening screws for bracket	21 - 26
Fastening nuts for injection nozzles	12 - 15
Fuel lines	18 - 20
Cylinder-head cover	6 - 8





460/1666

### 3. Terminal diagram, flame starting system (non-Bosch equipment)

1 = Glow-duration unit

2 = Test plug, cold start

3 = Control lamp

4 = Solenoid-operated fuel valve

5 = Series resistor, flame glow plug

6 = Flame glow plug

7 = Solenoid-operated starting switch

8 = Starting motor

9 = Battery

a = Plug-in connection

b = Alternator

c = Alternator

d = Plug-in connection

A5

Terminal diag., flame starting system

Ford

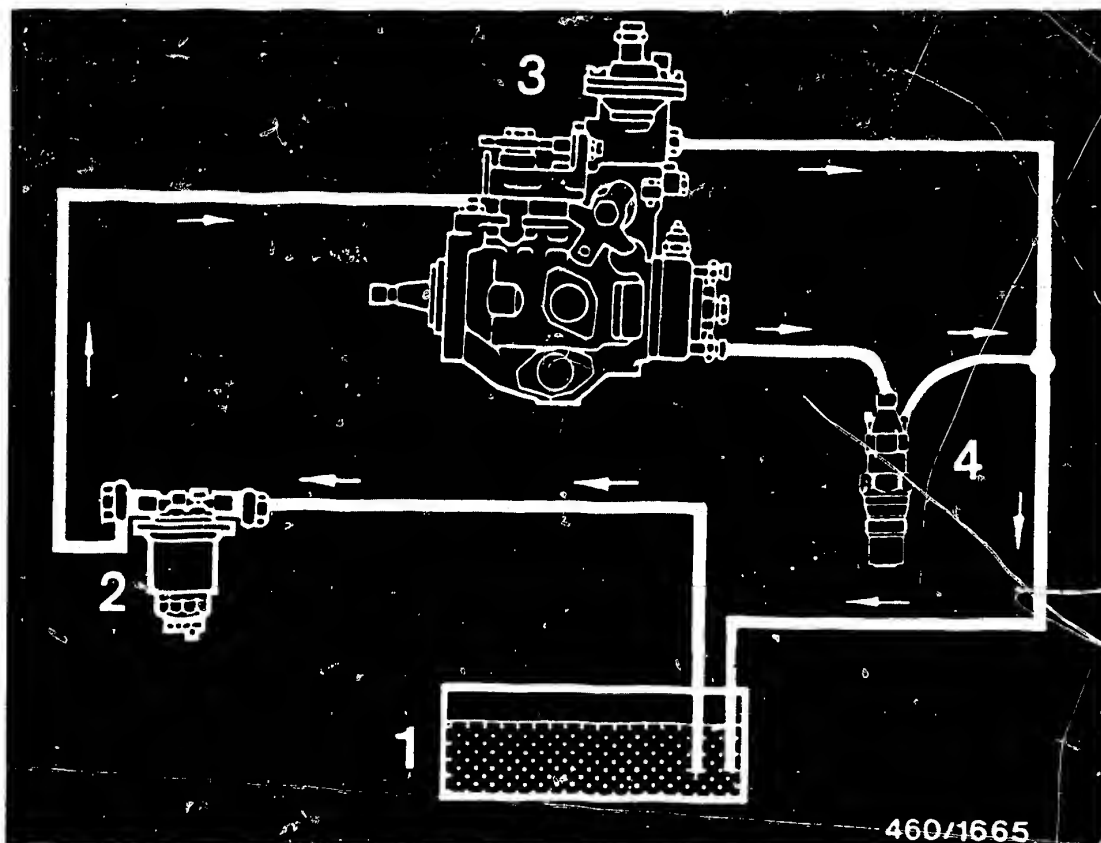


A6

Terminal diag., flame starting system

Ford





1 = Fuel tank  
2 = Fuel filter

3 = Distributor-type injection pump  
4 = Injection nozzles

#### 4. Diagram of fuel lines

The fuel lines are connected according to the above diagram.

The fuel flows in the direction of the arrows.



## 5. Test equipment and tools

Description	Part number	Application
Setting pins	KDEP 1161/1	Locking injection pump gear
KDEP 1161 consisting of:	KDEP 1161/1	Locking camshaft
	KDEP 1161/3	Locking flywheel
Measuring tool	KDEP 1085	Coordination, pump – engine (injection timing)
Adapter for measuring tool	KDEP 1127	Coordination, pump – engine (injection timing)
Mini dial indicator	Commercially available	Coordination, pump – engine (injection timing)
1/100 mm divisions	e.g. Hahn u. Kolb D-7000 Stuttgart Part No. 33 003	
Locating pin	KDEP 1150	Location of drive shaft
Timing-device cover	KDEP 1151	For adjusting start of delivery acc. to plunger lift of pump



<u>Test equipment and tools (continued)</u>		
Description	Part number	Application
Nozzle tester	EFEP 60 H O 681 200 502	Testing injection nozzles
Pressure-drop tester	EFAW 210 A O 681 001 901	Testing engine pressure drop
Tachometer	Commercially available e.g. Dr.E.Horn GmbH Meßgerätefabrik Postfach 40 D-7036 Schönaich Order code: HT 446 (with digital indicator)	Adjusting engine speed
Differential-pressure gauge	Commercially available Part No. NG 160/311-911 -1.0 + 4.0 bar Haenni Co. Nauheimer Str. 78 - 80 D-7000 Stuttgart 50	Filter test
Evaluating unit	O 684 102 050	Smoke test
Accessory box with smokemeter sampling pump	O 681 169 038	
Compression tester	Commercially available	Testing engine compression
Pre-heating tester	ETT 011.00 O 684 101 100	Testing flame starting system

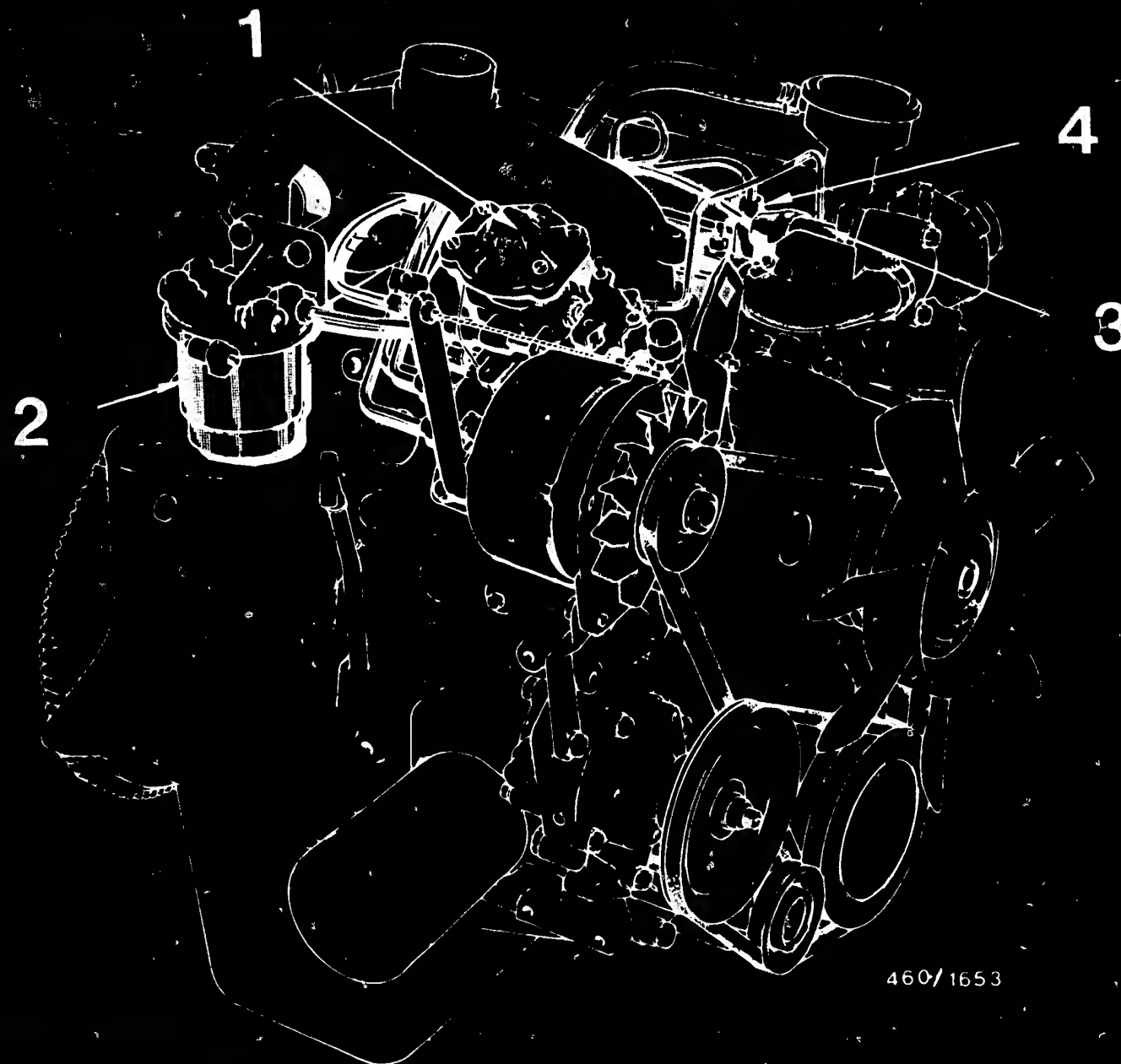




Test equipment and tools (continued)

Description	Part number	Application
Flat double-end flare nut wrench	Commercially available e.g. Hazet Hermann Zerver D-5630 Remscheid 1  Part No. 612 A- 5/8 x 3/4	Loosening/tight- ening fuel- injection tubing
Nozzle-cleaning kit	KDEP 2900	For cleaning hole-type nozzles





460/1653

# 6. Installation position of components

1 = Fuel-injection pump  
2 = Fuel filter

3 = Wax thermostat  
4 = Injection nozzles

**A11**

Installation position of components  
Ford



**A12**

Installation position of components  
Ford



## 7. Trouble-shooting

### Customer complaint (symptom of trouble)

1. Engine fails to start or starts only with great difficulty when warm.
2. Engine fails to start or starts only with great difficulty when cold.
3. Engine hunts when idling.
4. Rough idling when engine is warm.
5. Engine misfires during vehicle operation.
6. Unsatisfactory performance.

						Cause (component fault)	Coordinate
•	•	•		•	•	Tank empty; tank vent clogged	B 5
•		•		•	•	Injection sequence does not correspond to firing sequence (test laying of fuel-inj. tubing)	B 6
		•		•	•	Overflow restriction clogged	B 7
•	•					Shutoff device defective	B 8
			•	•	•	Air in fuel system	B 13
		•		•		Heavy paraffin deposits in filter in winter operation (replace filter box)	B 14
				•		Lines leaking or broken; connections loose	B 15
						Supply lines clogged (test fuel lines)	B 16
		•		•	•	Fuel-injection tubing clogged or constricted (test fuel lines)	B 16
		•		•		Engine air filter clogged	B 17
	•					Idle speed incorrect	C 5
			•			Injection nozzle defective	C 1
	•					Flame starting system defective	D 1
	•	•		•		Start of pump delivery incorrect	F 11
		•		•		Fuel filter clogged (differential-pressure test)	C 22
	•	•				Timing device defective (remove fuel-injection pump)	D 7
				•		Engine compression poor or uneven	D 8
			•			Maximum speed incorrectly adjusted (remove fuel-injection pump)	D 9
•	•	•	•	•	•	Fuel-injection pump (governor) defective or out of adjustment (remove fuel-injection pump)	D 19

**B1**

Trouble-shooting

Ford



**B2**

Trouble-shooting

Ford



# Trouble-shooting (continued)

7. Fuel consumption too high.

8. Engine cannot be switched off.

9. Engine runs rough, black smoke in full-load range; possibly lack of power.

10. Fog-like smoke in full-load range (white).

11. Incorrect engine speeds.

12. Engine will not rev up when cold.

13. Distributor-type fuel-injection pump becomes too hot.

<u>Cause</u>							<u>Coordinate</u>
			•		•		Tank empty; tank vent clogged B 5
	•			•	•		Injection sequence does not correspond to firing sequence (test laying of fuel-injection tubing) B 6
					•	•	Overflow restriction clogged B 7
•							Shutoff device defective B 8
		•			•		Air in fuel system B 13
		•			•		Heavy paraffin deposits in filter in winter operation (replace filter box) B 14
					•		Lines leaking or broken; connection loose B 15
		•			•		Supply lines clogged (test fuel lines) B 16
		•			•		Fuel-injection tubing clogged or constricted (test fuel lines) B 16
	•	•			•		Engine air filter clogged B 17
	•						Idle speed incorrect C 5
				•			Injection nozzle defective C 16
	•						Flame starting system defective D 1
•	•	•			•		Start of pump delivery incorrect F 11
		•			•		Fuel filter clogged (differential-pressure test) C 22
	•	•					Timing device defective (remove fuel-injection pump) D 7
•					•		Engine compression poor or uneven D 8
							Maximum speed incorrectly adjusted (remove fuel-injection pump) D 19
•	•	•	•	•	•	•	Fuel-injection pump (governor) defective or out of adjustment (remove fuel-inj. pump) D 19

**B3**

Trouble-shooting

Ford



**B4**

Trouble-shooting

Ford



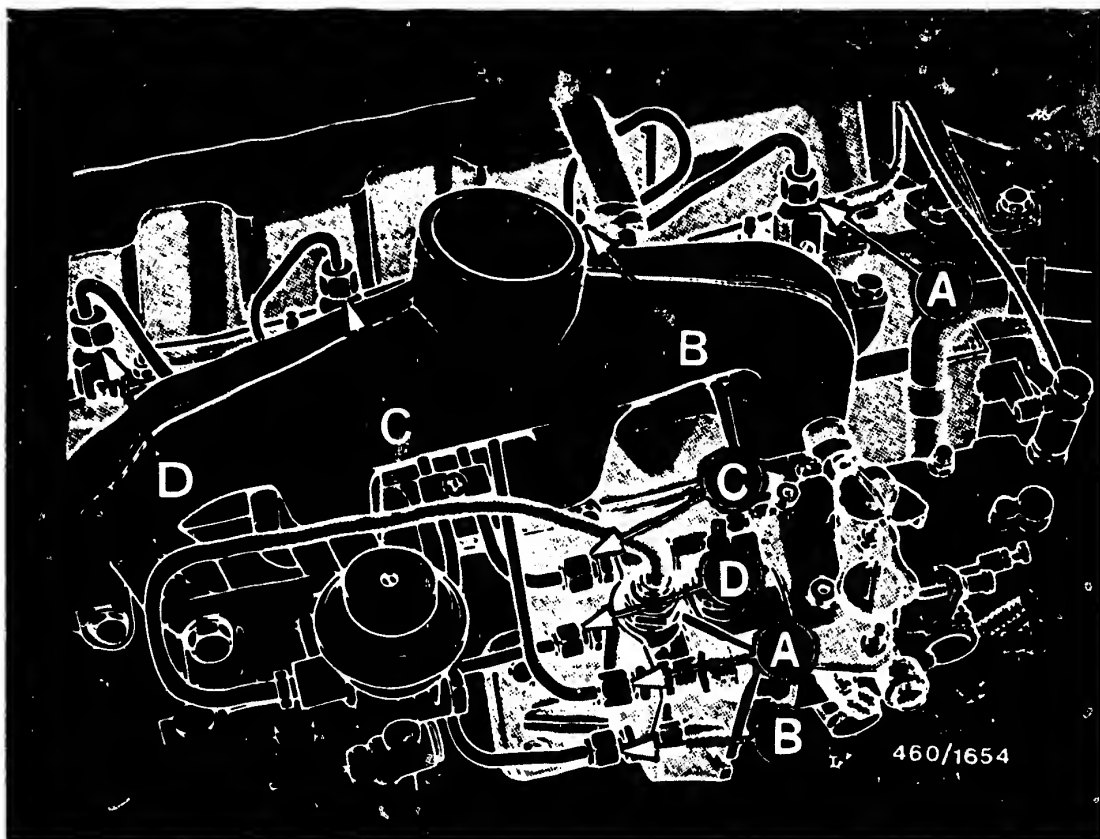
## 8. Check tank vent

Open tank filler cap.

If the fault disappears after opening the filler cap, the tank vent is defective.

Check tank vent for clogging.





### 9. Check routing of fuel-injection tubing

The individual fuel-injection lines are held together by clamps so that it is impossible for the outlets to be mixed up. If, however, there is any doubt, check the routing of the lines as shown in the picture above. The pairing of the fuel-injection pump outlets with the individual engine cylinders is identified by the letters A - D.

**B6**

Check fuel-injection tubing

Ford



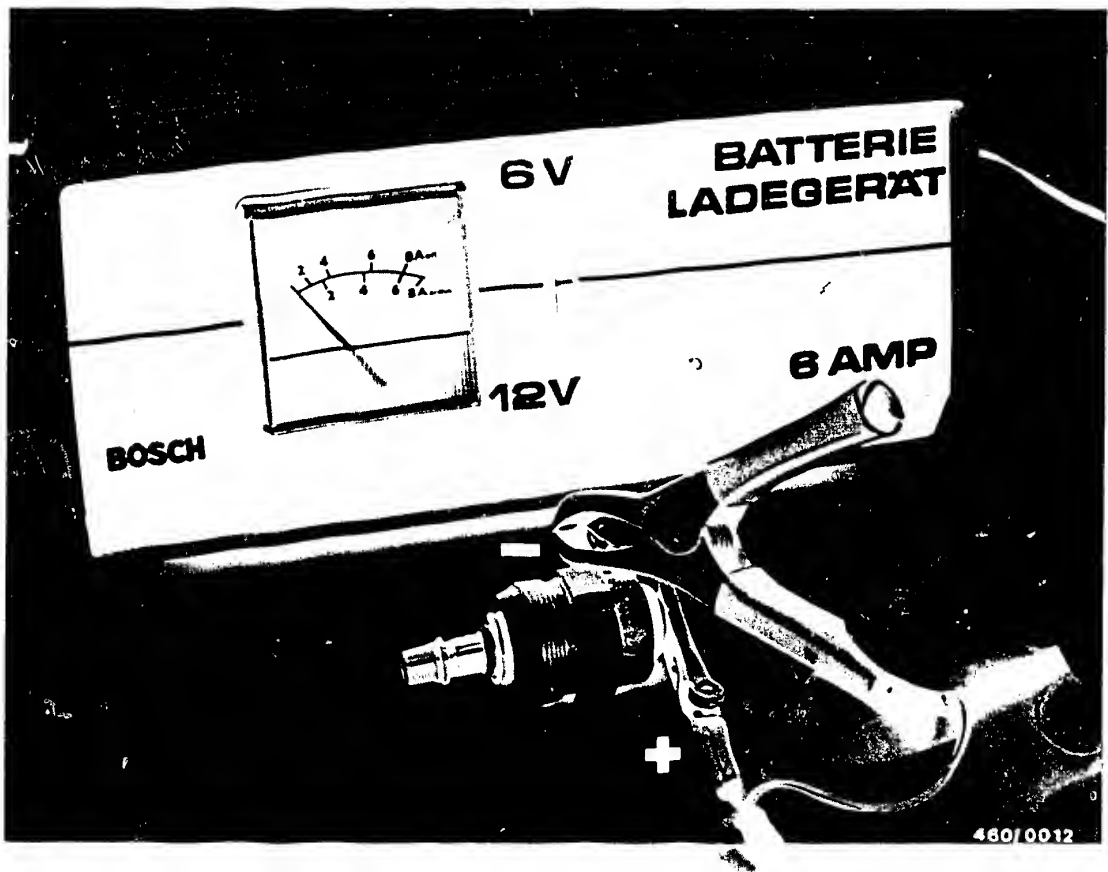


### 10. Check overflow restriction

Unscrew overflow restriction (arrow) on fuel-injection pump (marked "out").

Perform visual inspection of wire screen for impurities. If in doubt, replace overflow restriction.





## 11. Check operation of shutoff device

### 11.1 Engine fails to start

Check whether solenoid-operated valve is supplied with voltage (min. 10 V) with glow-plug and starter switch switched on (drive position).  
 If voltage is present, remove fuel-injection tubing and take out solenoid-operated valve.  
Cleanliness is essential.

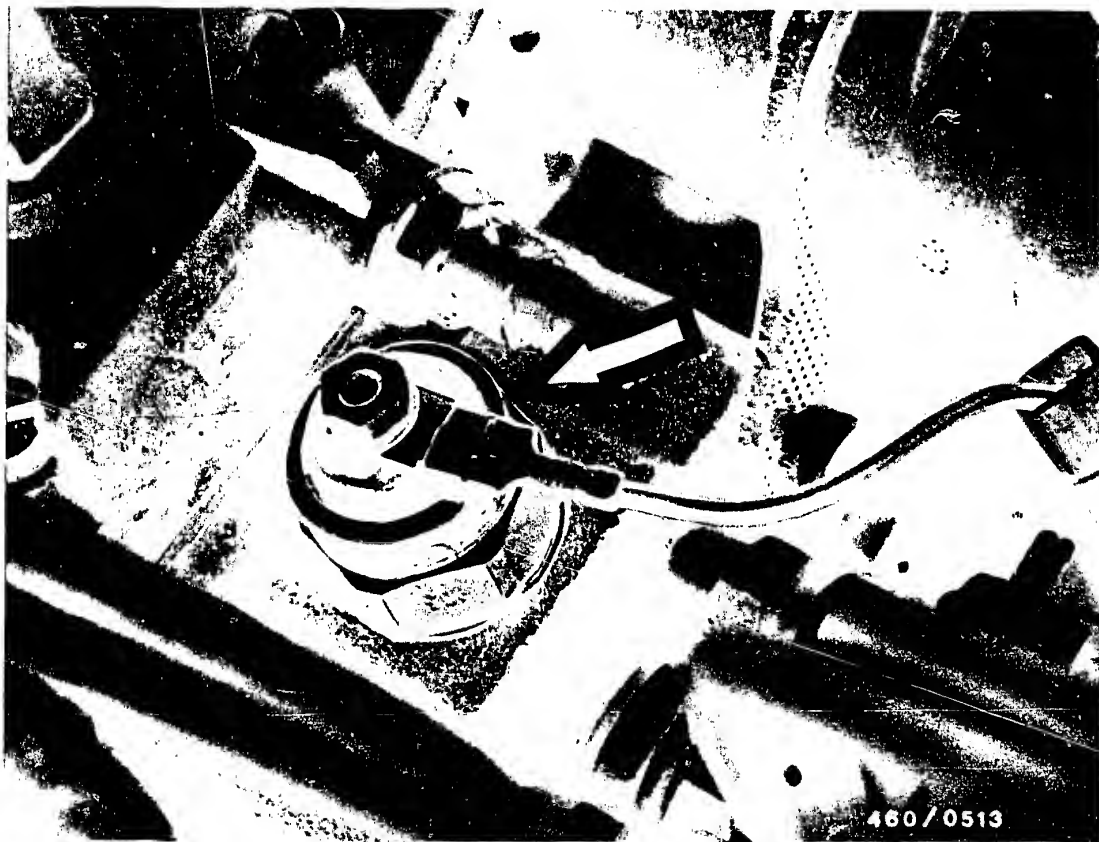
When removed, check operation of solenoid-operated valve.

#### Note:

When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.





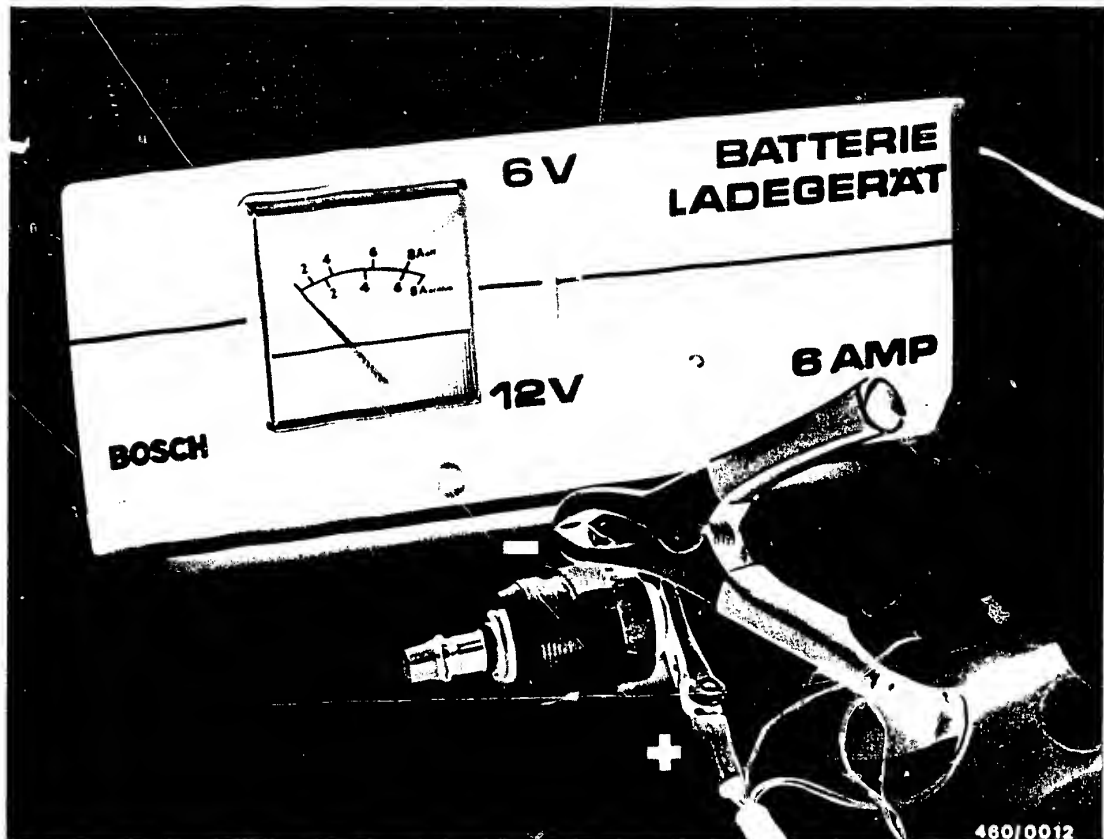


### 11.2 Engine cannot be switched off

With the glow-plug and starter switch in the stop-position there must be no voltage across the solenoid-operated valve (arrow), i.e. the fuel inlet to the distributor-pump plunger is interrupted.

If the engine continues to run although there is no voltage across the solenoid-operated valve, the engine can be stopped as follows:  
Select 3rd or 4th gear. Jam on foot brake and slowly let out clutch pedal.





### 11.3 Solenoid-operated valve test

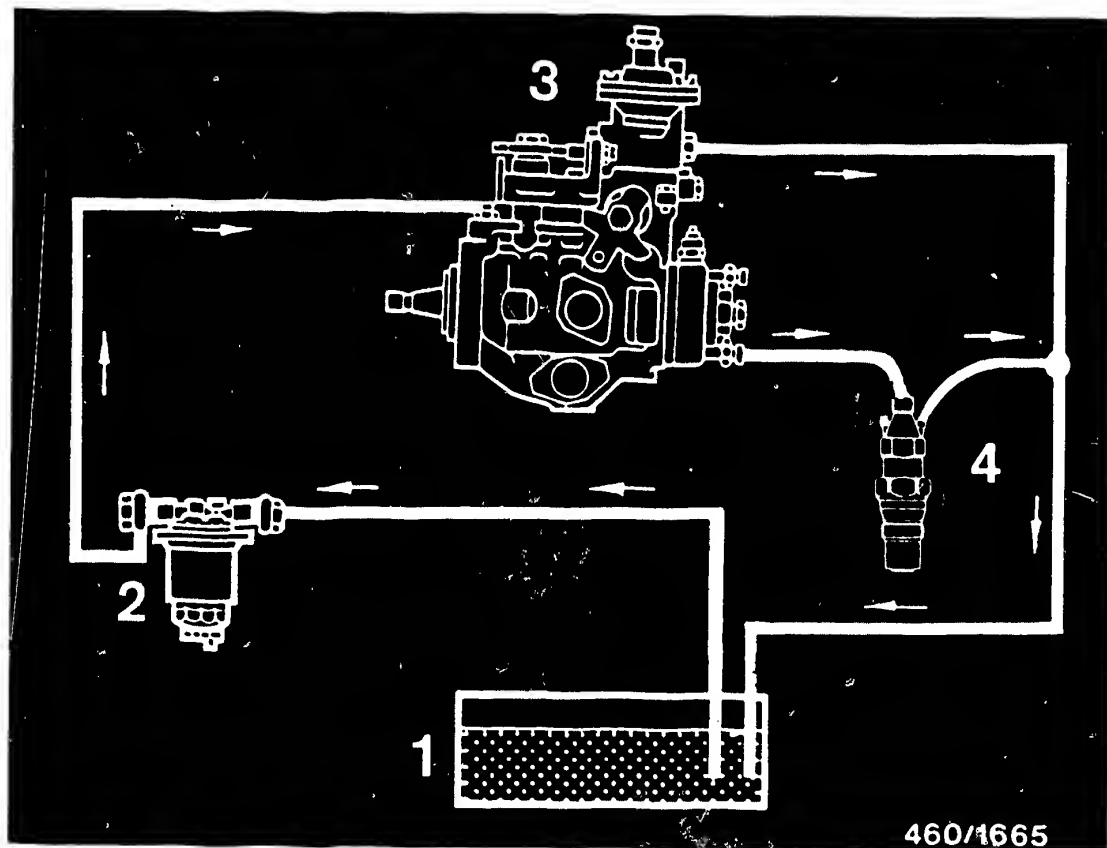
Remove fuel-injection tubing.  
Take out solenoid-operated valve.  
Cleanliness is essential.

When removed, check operation of solenoid-operated valve.

#### Note:

When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.  
Check valve seat in hydraulic head (visual inspection).





1 = Fuel tank  
2 = Fuel filter

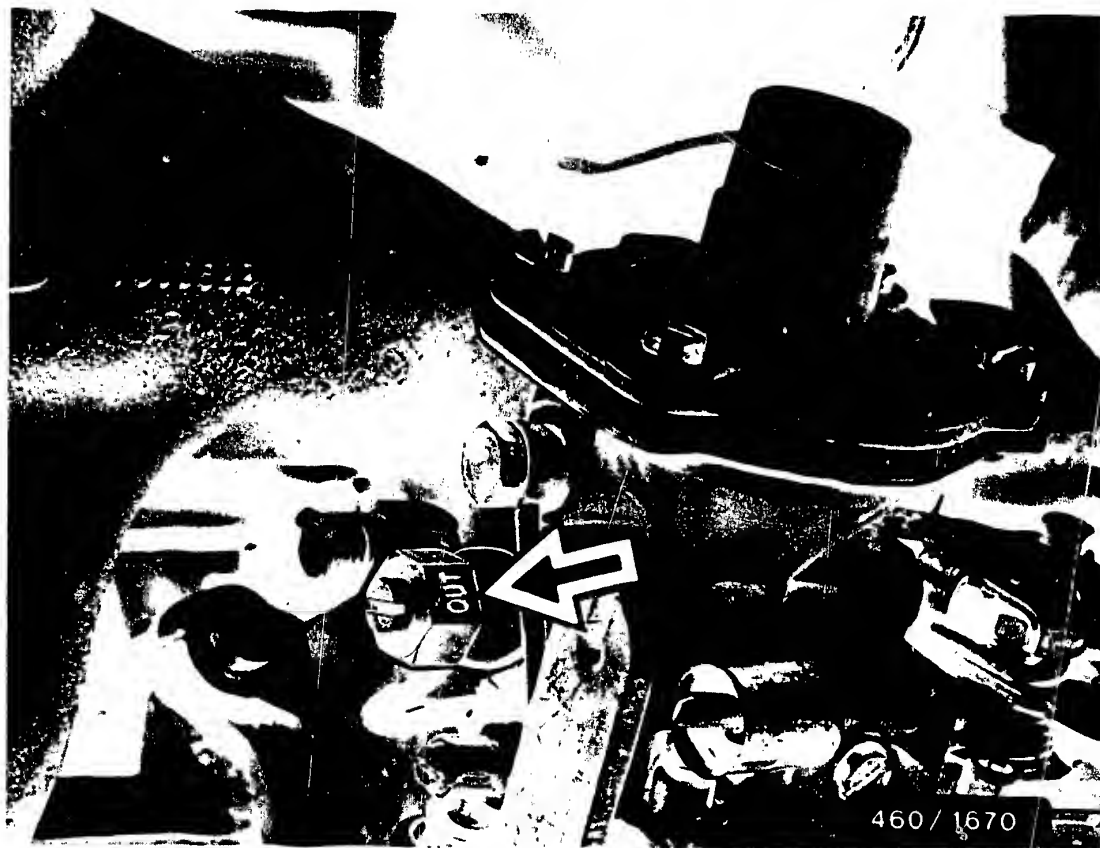
3 = Distributor-type injection pump  
4 = Injection nozzles

## 12. Diagram of fuel lines

The fuel lines are connected as shown in the above diagram.

The fuel flows in the direction of the arrows.





The throttle screw is part of the pump and is marked with the word "Out".

As regards the connections to the fuel-injection pump, ensure that the inlet-union screw for fuel inlet and the throttle screw are not mixed up.



### 13. Bleed fuel system

Set glow-plug and starter switch to "engine running" position.

Loosen bleeder screw on fuel filter (arrow).

Operate supply pump until fuel escaping from the bleeder screw is free of bubbles.

Tighten bleeder screw.

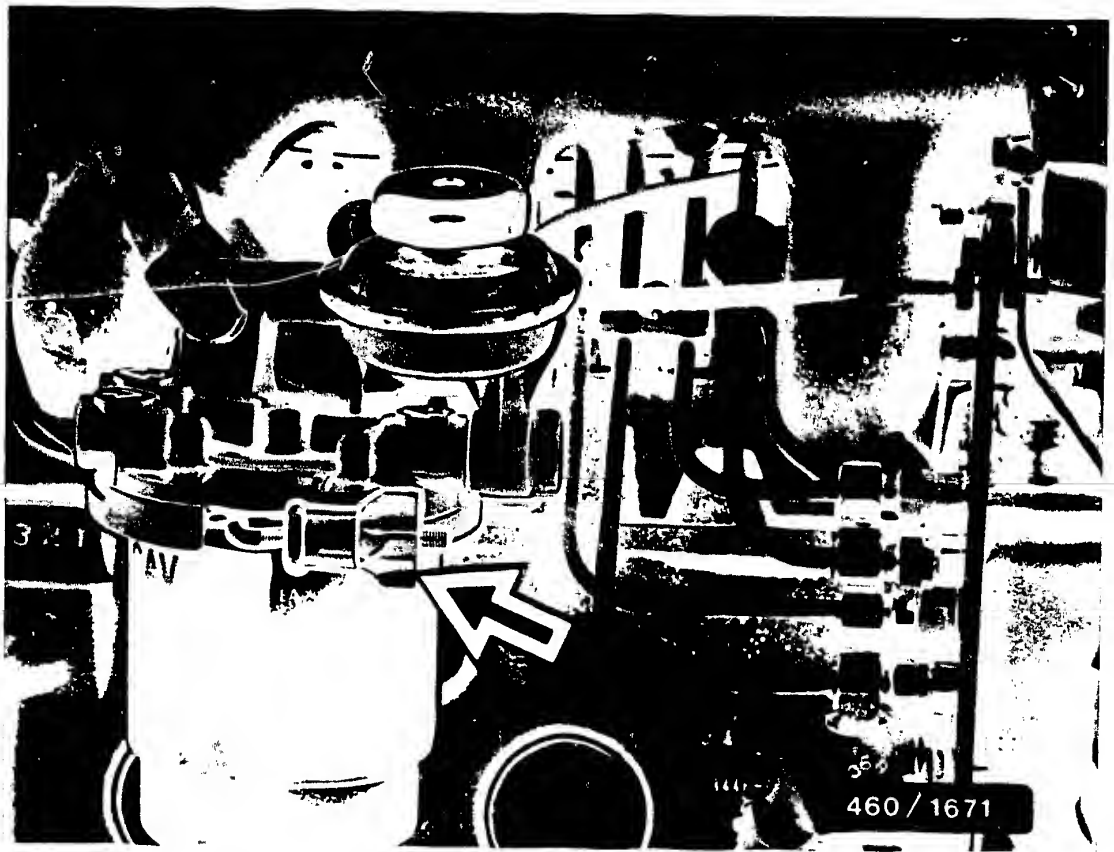
Loosen union nuts of fuel-injection tubing at the injection-nozzle-holder assemblies.

Actuate starting motor until fuel escapes from union nuts of nozzle-holder assemblies.

Tighten union nuts.

Actuate starting motor until engine starts.





#### 14. Replace and drain water from fuel filter

##### Replace filter box

Loosen wing nut (arrow) on clamping clip of filter cartridge.

Carefully pull off filter cartridge from filter head.

Catch escaping fuel. Position new filter cartridge at filter head and make certain that it sits properly.

Tighten wing nut on cartridge clamping clip.

- Do not overtighten.



## 15. Check fuel-injection system for leaks

Perform leak test with engine at normal operating temperature.

Check all fuel-line connecting points.

Pay particular attention to:

- Connections on nozzle-holder assemblies.
- Connections and joints on fuel filter.
- Supply and return lines on distributor-type fuel-injection pump.
- Delivery-valve holder on distributor head.

Check fuel lines for hairline cracks.





## 16. Check fuel lines

Subject suspect fuel lines to a visual inspection.

If there is no detectable pinching or kinking, the fuel line in question must be removed.

Check fuel line for throughflow using compressed air and clean if necessary.

A suitable hose piece may be used as a side seal for blowing out the fuel lines.







## 17. Smoke test - check air filter

### Test setup

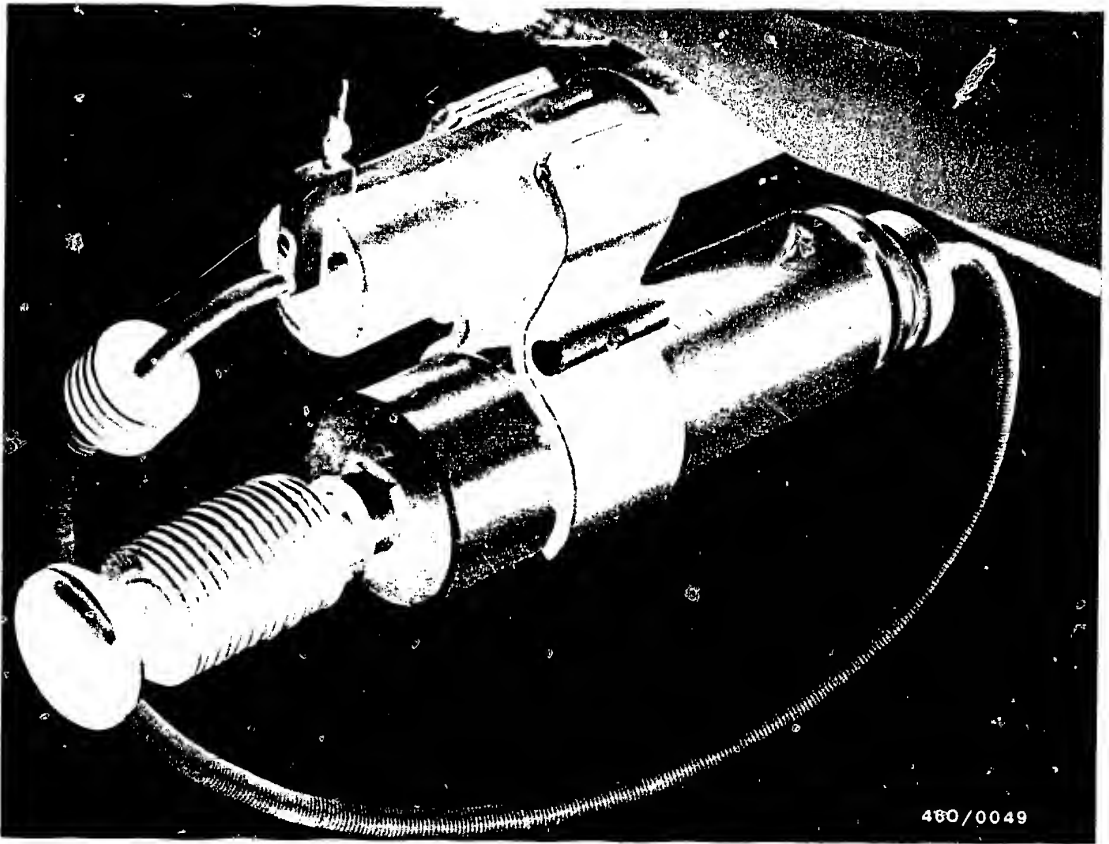
The smoke test is conducted using the Bosch filter-type.

The filter-type smokemeter consists of the following units:

- Accessories box with proportioning 0 681 169 038  
or 0 681 169 058
- Evaluating unit 0 684 102 050

Insert filter plate into proportioning pump  
(with filter-type smokemeter 0 681 169 038).





Mount appropriate sampling pump on exhaust pipe using appropriate clamp.

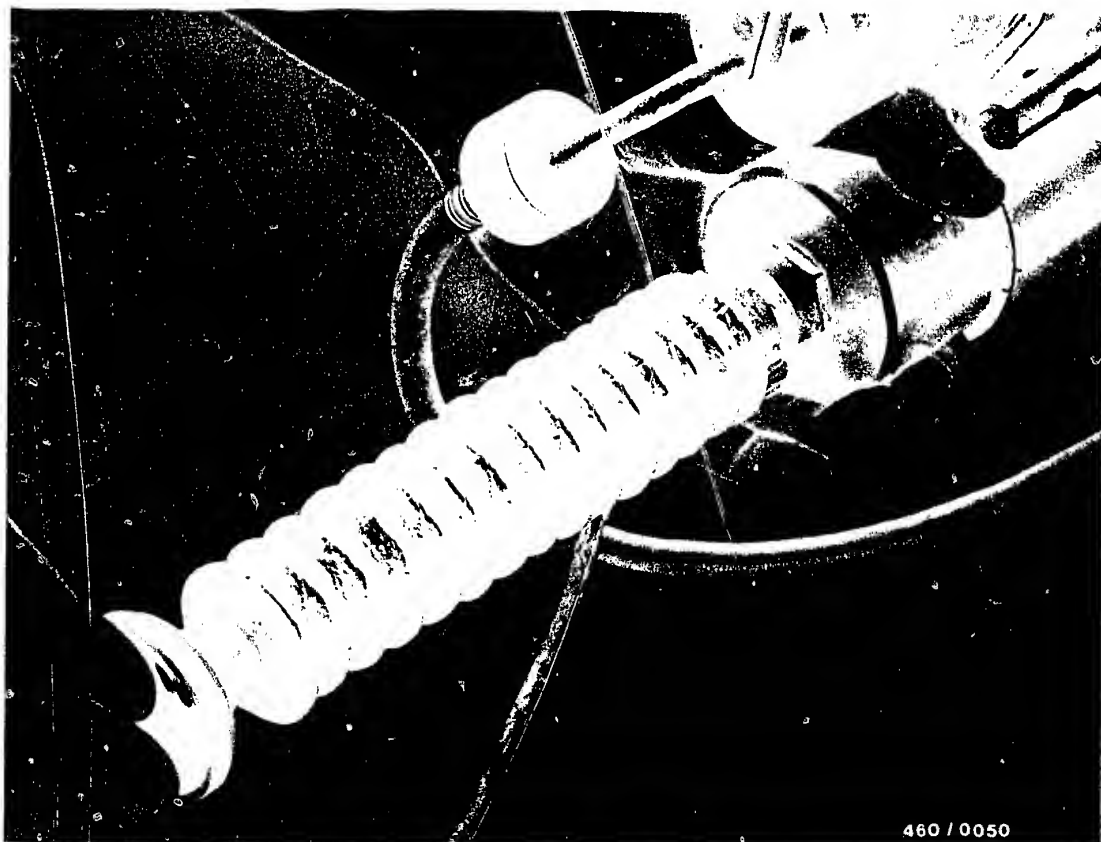
Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.

**B 18**

Smoke test

Ford





### 17.1 Measurement using steady-state method

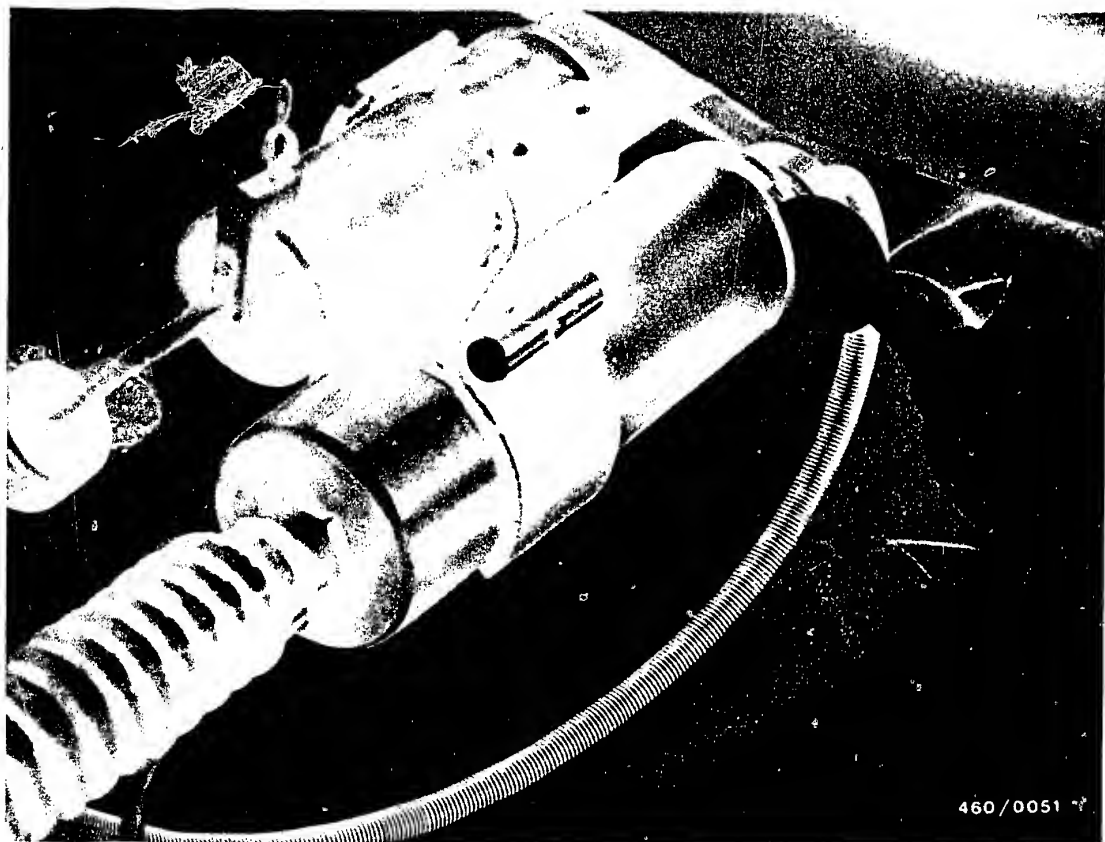
Set proportioning pump by pressing in the black push-button.

Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case. Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached. Load the engine so that, with the accelerator in the same position, a speed of approx. 25 km/h is reached.





Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

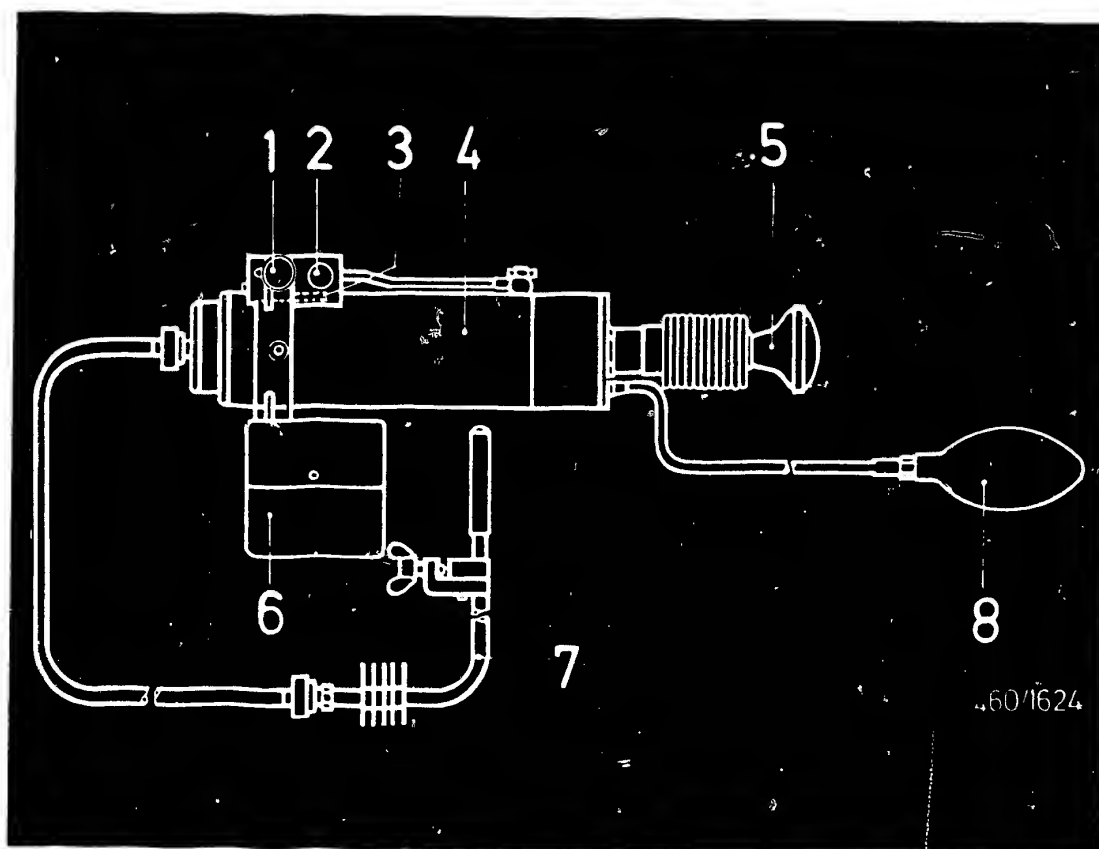
Switch off engine.

Caution!

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

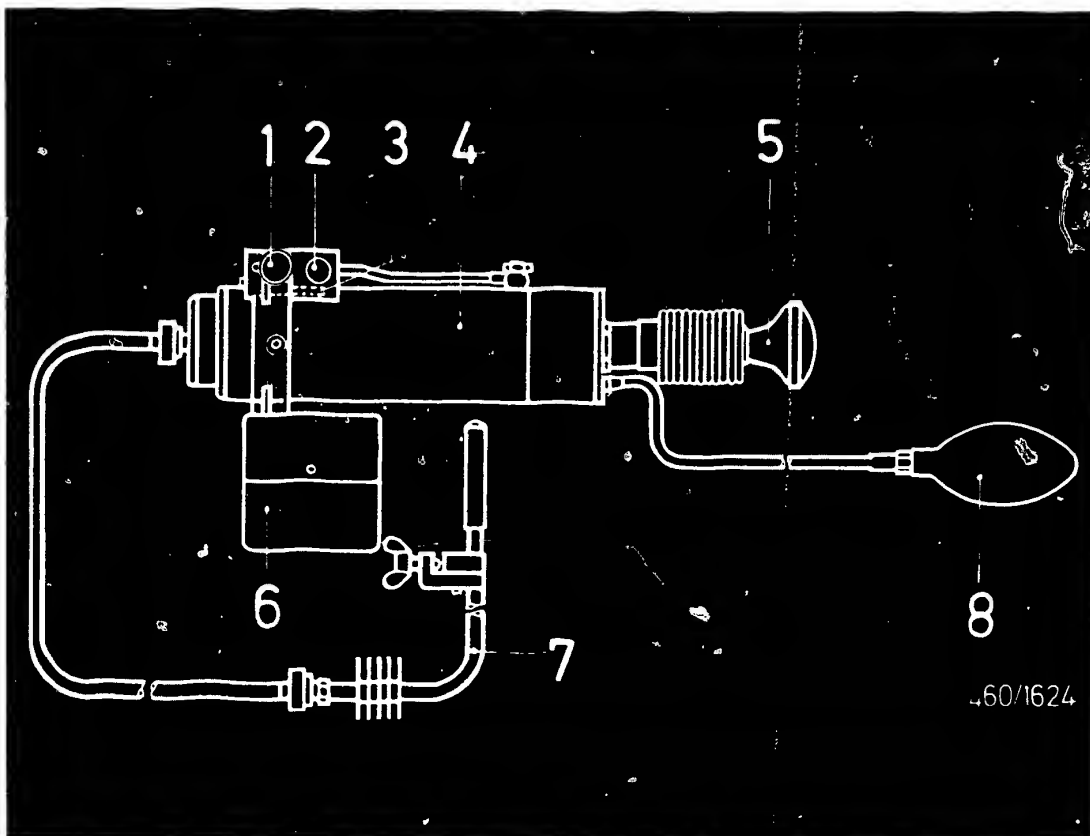
Remove filter plate from sampling pump.





- 1 = Rotary knob for paper transport
- 2 = Push-button for actuation by compressed air
- 3 = Compressed-air connection
- 4 = Proportioning pump
- 5 = Manual actuation mechanism
- 6 = Magazine for filter-paper roll
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

17.2 Measurement using the acceleration method in conjunction with filter-type smokemeter '0 681 169 058.



460/1624

### Operation - proportioning pump:

The piston of the proportioning pump may be brought to the operating position by hand or with compressed air.

Activation of the compressed air is by means of a corresponding connection (3) and a push-button (1).

Clamp proportioning pump.

## Test requirement:

In view of the problems of handling and manual operation, we recommend that tests not be performed outside when it is raining or when the air temperature is below 0°C.

The engine must be at normal operating temperature when taking measurements (coolant temperature at least 60°C).

## C A U T I O N !

During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

## Test procedure:

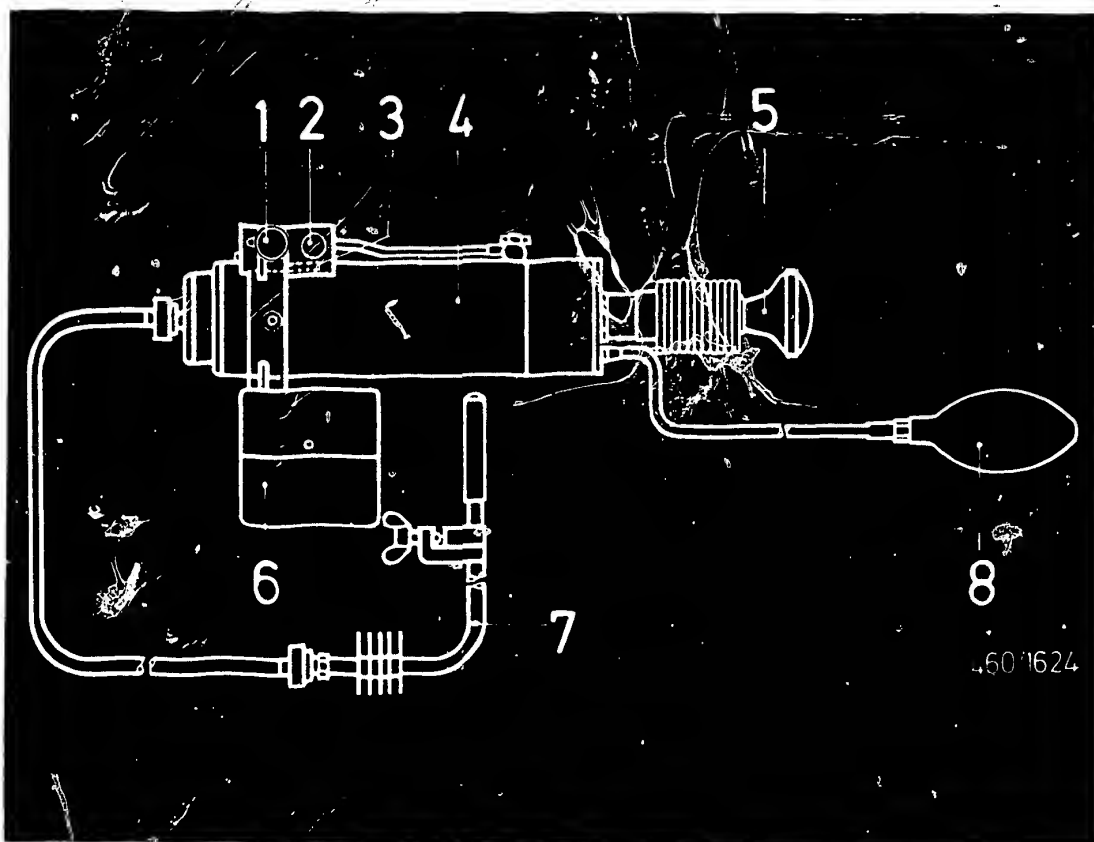
To clean the exhaust system, accelerate the engine at least three times in rapid succession to its breakaway speed immediately before testing.

Approx. 1 second before accelerating for the 4th time, trigger the induction stroke of the proportioning pump by pressing the rubber ball.

Afterwards, push the accelerator pedal fully and rapidly to the floor until the maximum engine speed is obtained and the fuel-injection pump governor regulates.

When the breakaway speed is reached, immediately release accelerator pedal (idle position).





- 1 = Rotarty knob for paper transport
- 2 = Push-button for actuation by compressed air
- 3 = Compressed-air connection
- 4 = Proportioning pump
- 5 = Manual actuation mechanism
- 6 = Magazine for filter-paper roll
- 7 = Exhaust-sample pickup
- 8 = Rubber ball

By actuating the push-button (2), the plunger is brought again into the operating position (when testing with compressed-air supply). Keep pressing the button until the plunger latches.

Transport the filter paper one notch further by turning the rotart knob (1) ( release and clamping of filter paper is performed automatically).





Repeat measurement three times.

Bring plunger to operating position and tear off the sooted measuring tape.

In the case of the acceleration measurement, individual tests must be performed until three consecutive "blackening figures" are obtained which do not deviate from one another by more than 1 Bacharach unit.

Note:

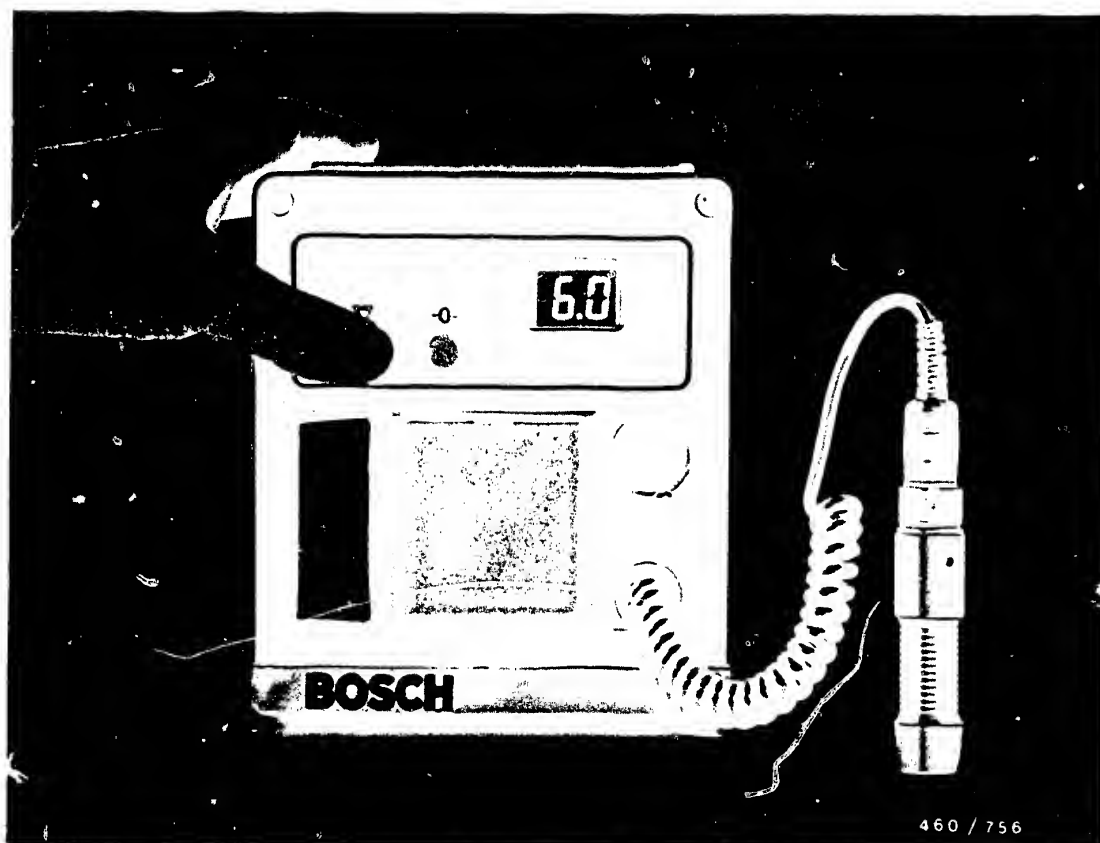
In the case of engines with selectable supercharging, the complete series of measurements must be performed with supercharging selected.

**C1**

Smoke test

Ford





### Evaluation on the filter plate

Set the zero point on the smokemeter evaluating unit.

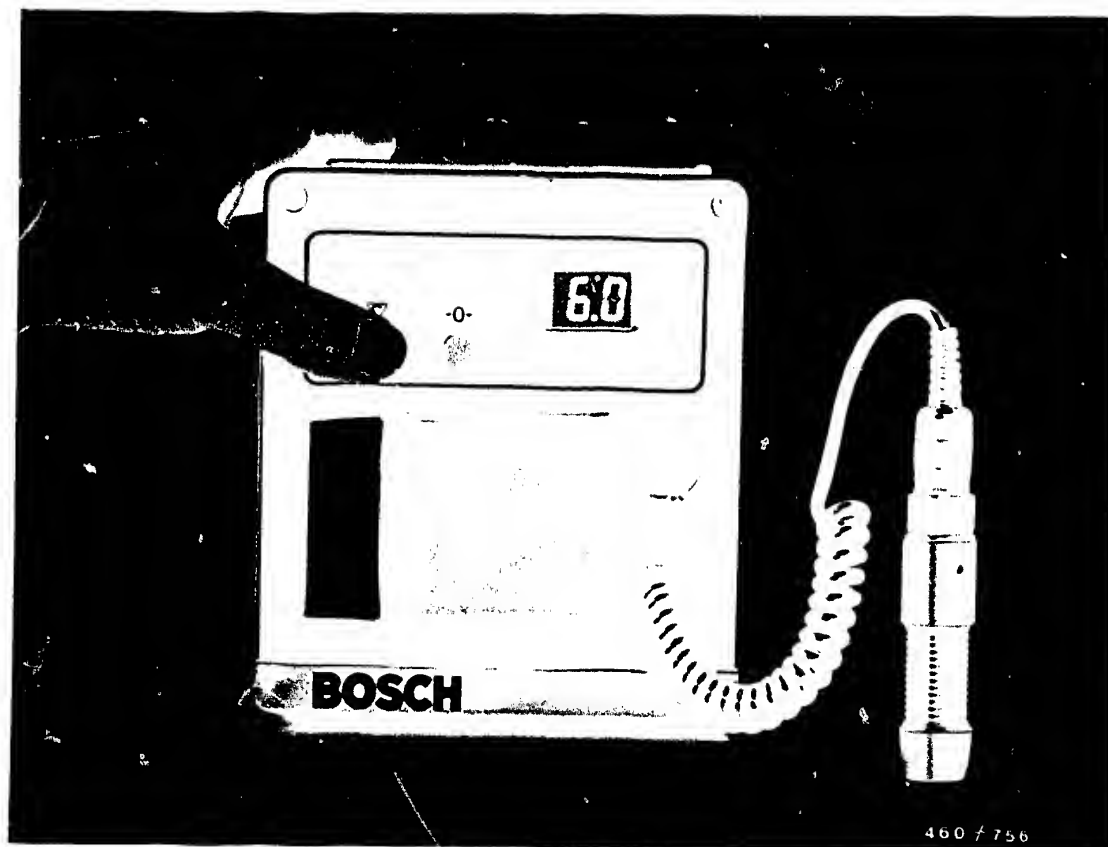
The zero point adjustment must be performed

- before each series of measurements
- if there are changes in the ambient conditions
- whenever the lens of the photo element adapter has been cleaned.

Firmly press the measuring head of the photo element adapter onto 5 clean white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears.  
Release button "0".





### Measuring

With sooted side at the top, place filter plate from metering unit on 3 new filter plates placed one on top of the other.

Press measuring head vertically onto black surface of filter plate, while at the same time pressing button "C" until the measured smoke number appears on the display.

### Note:

Measuring head must be firmly mounted both for the zero point adjustment and for measuring (even slight tilting may lead to incorrect measurements).

Compare the smoke number with the evaluation sheet.  
Note kW (HP) information of vehicle manufacturer.

### 17.3 Check air filter

Remove air filter and subject to a visual examination.

#### Test criteria for air filter:

- If air filter dusty -> knock out
- If air filter fouled with oil -> replace
- Remove solid matter in air filter (e.g. leaves).

If in doubt, use a new filter element.



18. Adjust idle speed

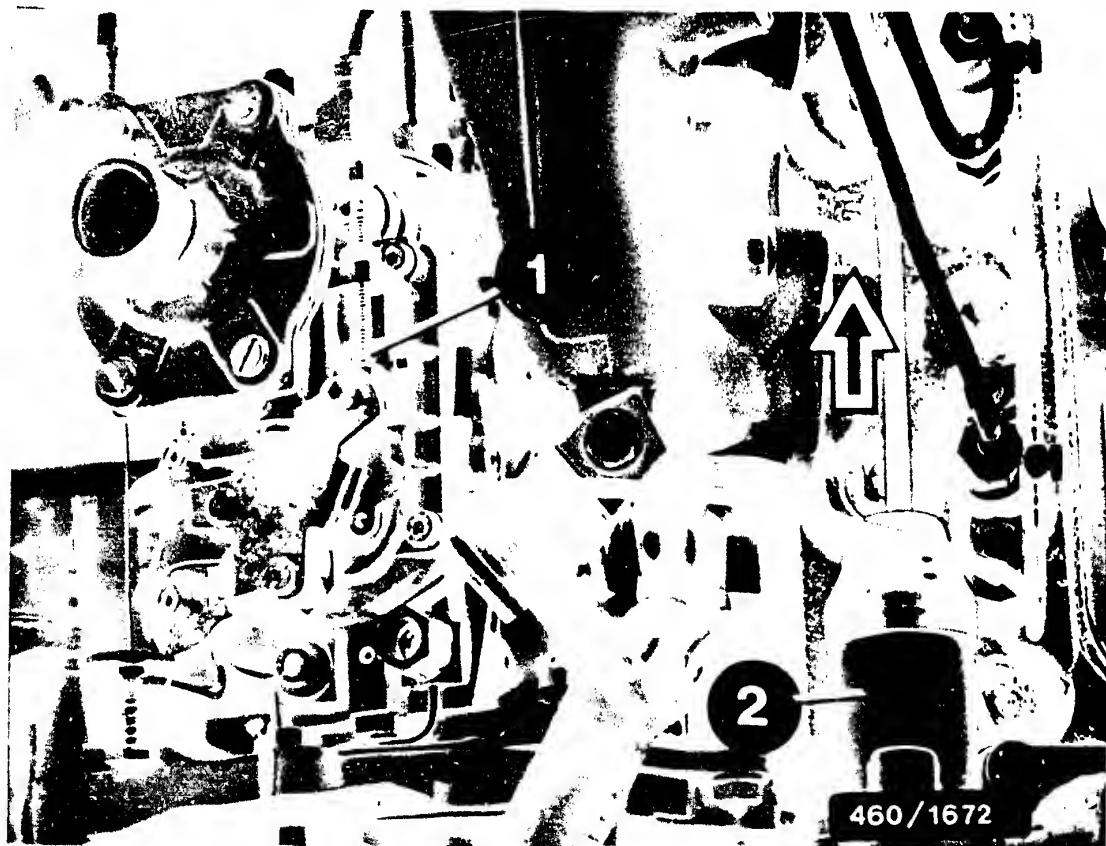
Connect tachometer (e.g. photo-electric) to engine.  
To do this, make a reflection mark on the crankshaft.  
Align digital hand-held tachometer with reflection  
mark and scan engine speed optically.  
Start engine and leave it running at idle speed.

**C5**

Adjust idle speed

Ford





### A t t e n t i o n !

For adjusting the idle speed, the engine must be at normal operating temperature (engine temperature  $+60^{\circ}\text{C}$ ).

The temperature-controlled idle-increase function must be switched off.

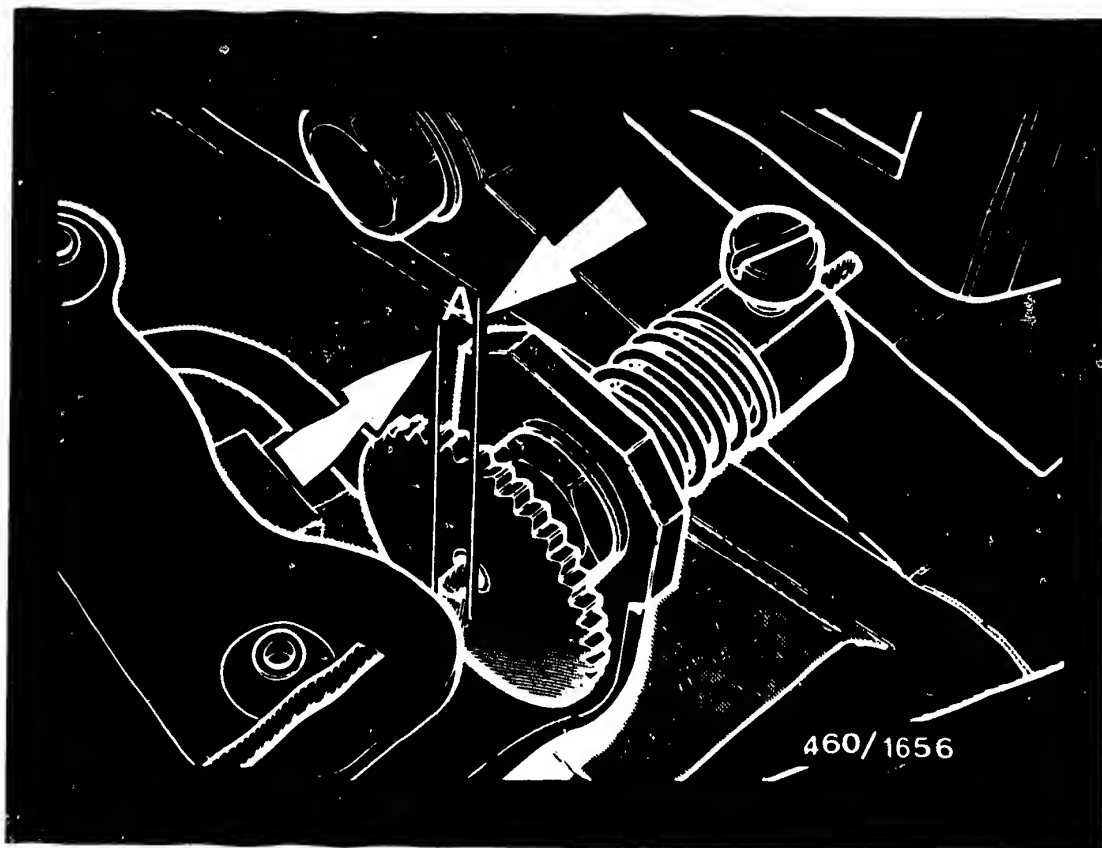
The control lever makes contact with the idle-speed adjusting screw (1).

Adjust engine speed to  $800 - 850 \text{ min}^{-1}$  at the idle-speed adjusting screw.

#### Note:

The crankshaft of the engine and fuel-injection pump are driven at half the engine speed.





18.1 Check clearance between control lever and knurled thumb screw (adjust)

Adjusting with engine warm

Prerequisite:

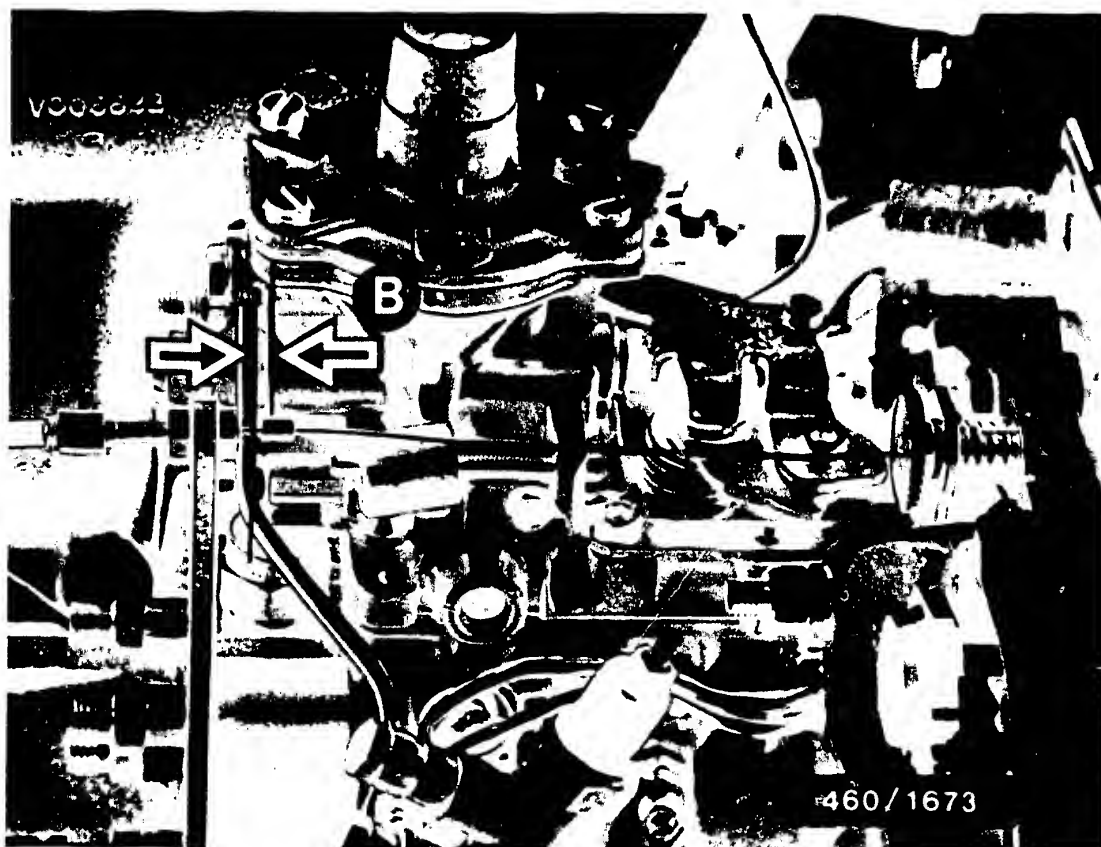
- Warm-idle adjustment O.K.
- Engine at normal operating temperature
- Control lever in contact with idle-speed adjusting screw.

Measure clearance "A" between control lever and knurled thumb screw.

Set value: A 2.5 - 3.5 mm

If set value not obtained, loosen lock nut and turn knurled thumb screw until set value is obtained.





### 18.2 Check clearance between nipple and adjusting sleeve (adjust)

Adjusting with engine cold

Prerequisite:

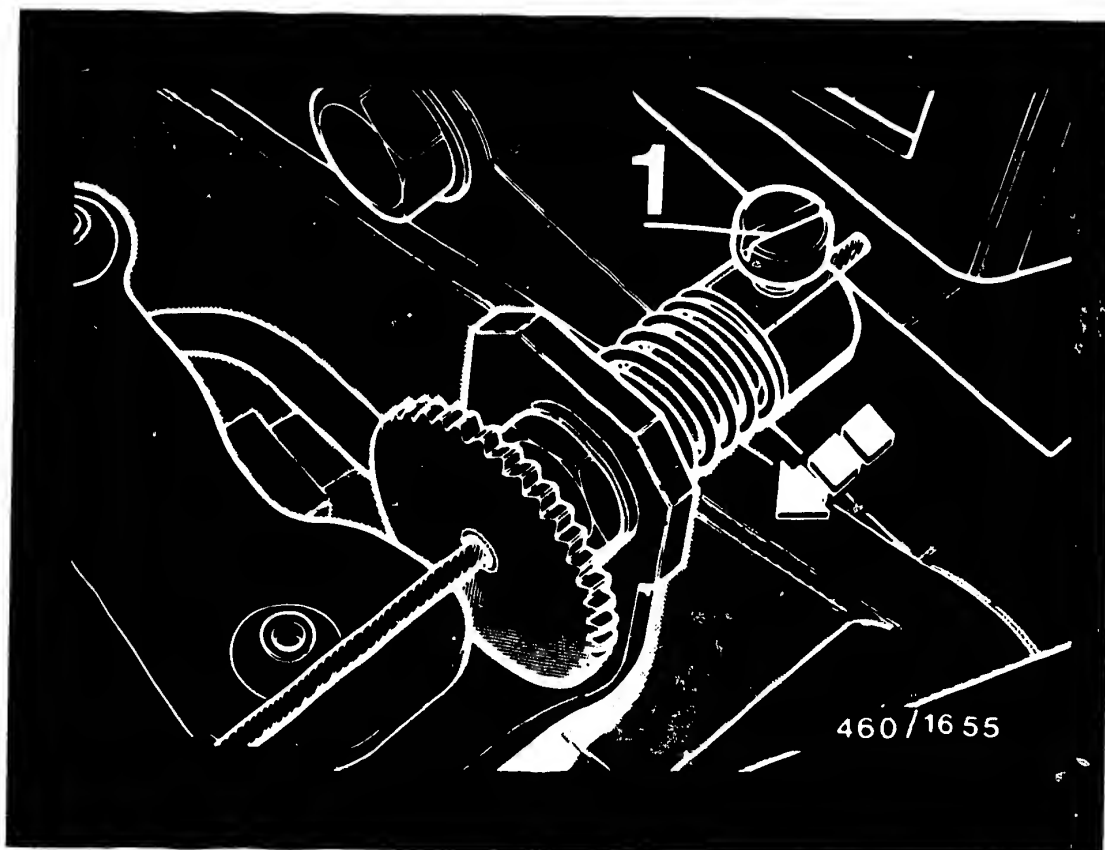
- Warm-idle adjustment O.K.
- Control lever in contact with idle-speed adjusting screw. Measure clearance "B" between nipple and adjusting sleeve.

Set value: B 2 - 3 mm

If set value not obtained, adjust clearance between nipple and adjusting sleeve.





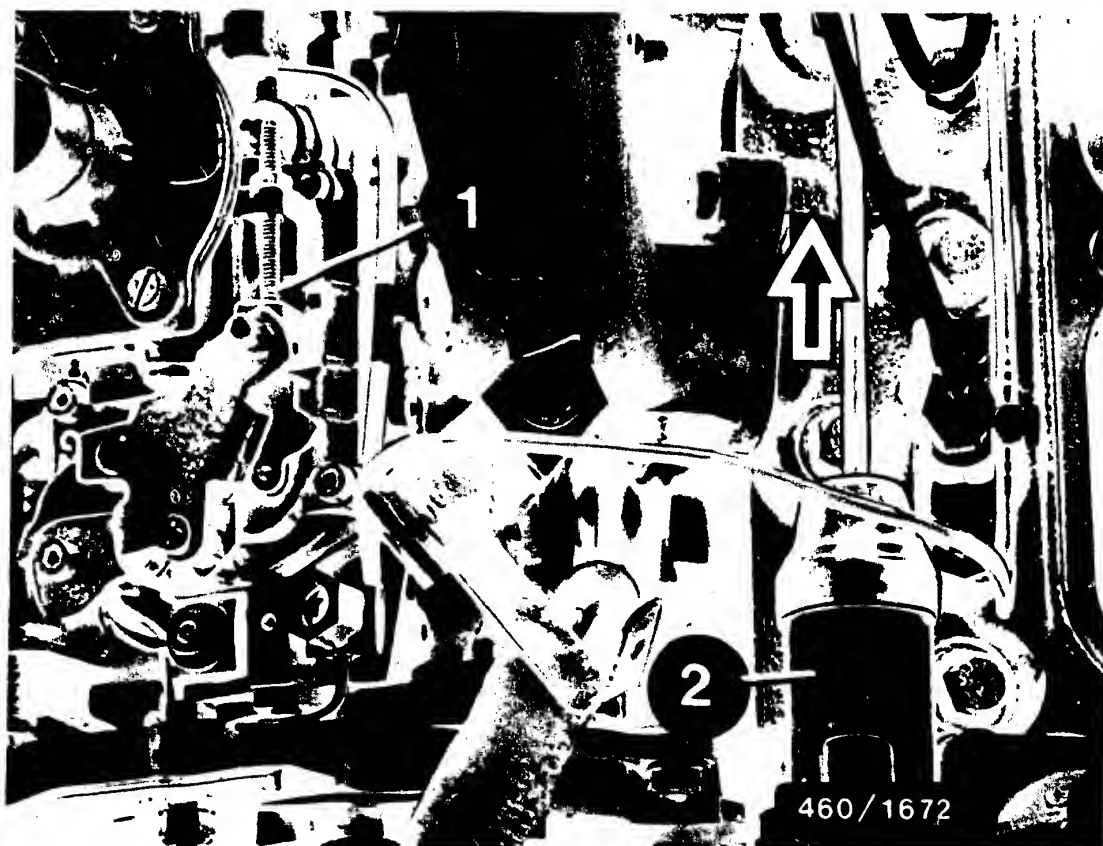


### 18.3 Adjust clearance between nipple and adjusting sleeve

Push control lever toward maximum-full-load-speed adjusting screw and temporarily fix in this position. Loosen clamping screw (1).

Push clamping piece against stop (arrow - engine-speed increase) and tighten fastening screw.

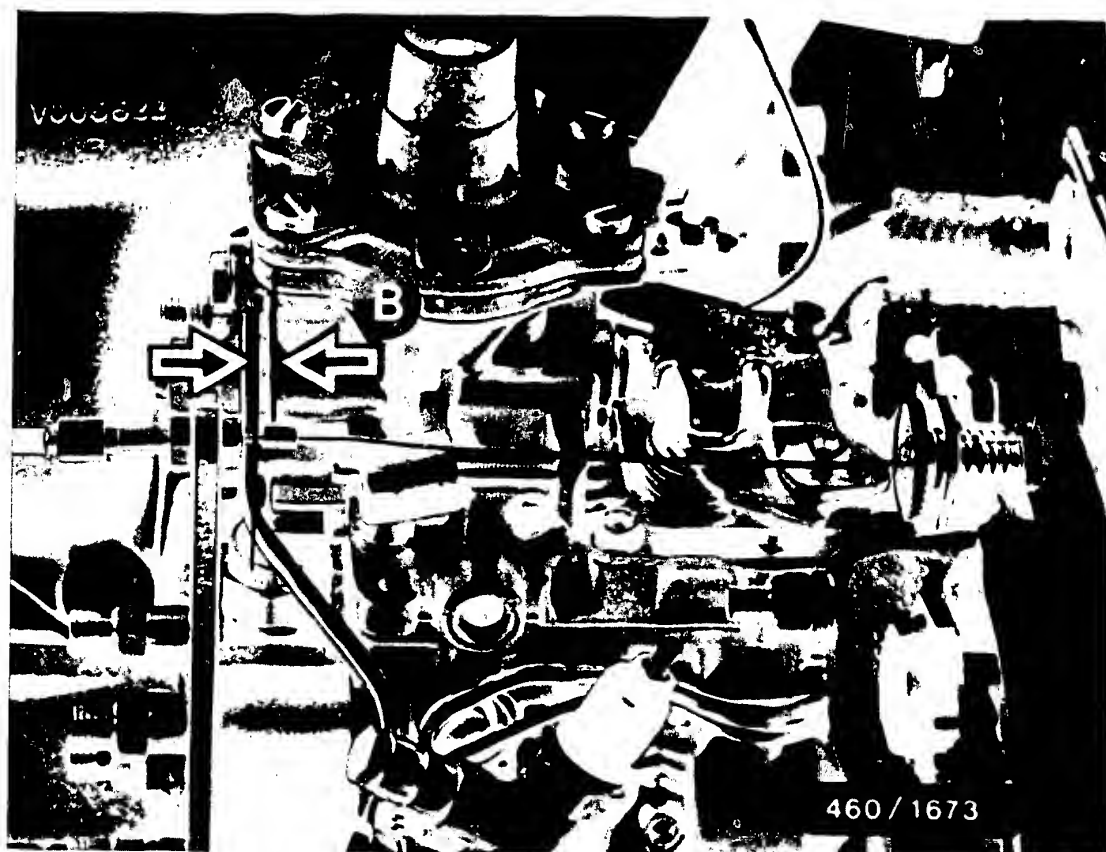
When tightening, make certain that the bowden cable is not kinked.



- 1 = Idle-speed adjusting screw  
2 = Wax thermostat

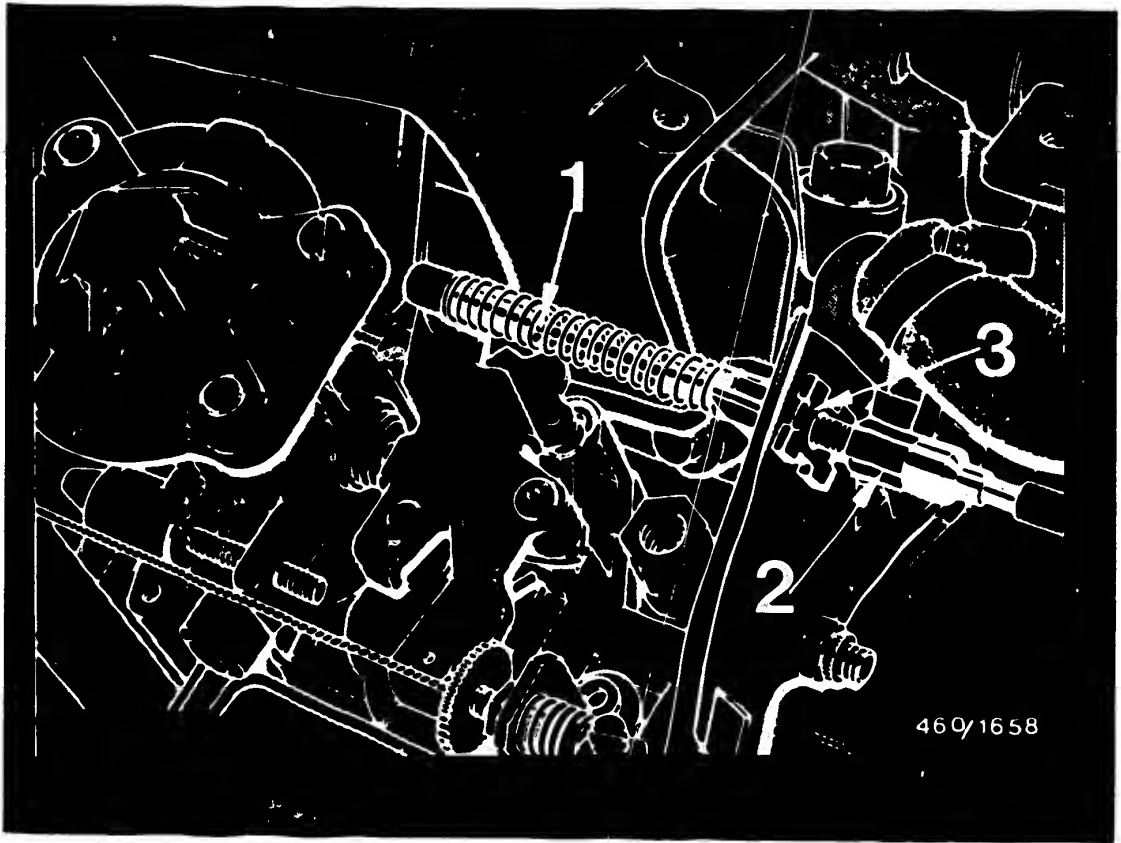
Pull actuating cable starting from the wax-thermostat end to the rear side of the engine in the direction of the arrow.





Adjust clearance between nipple and adjusting sleeve  
set value: 2 - 3 mm  
by altering the adjusting screw.  
Tighten lock nuts.

Remove mechanism used for fixing control lever.



1 = Actuating cable  
2 = Adjusting sleeve

3 = Steel-sheet clip

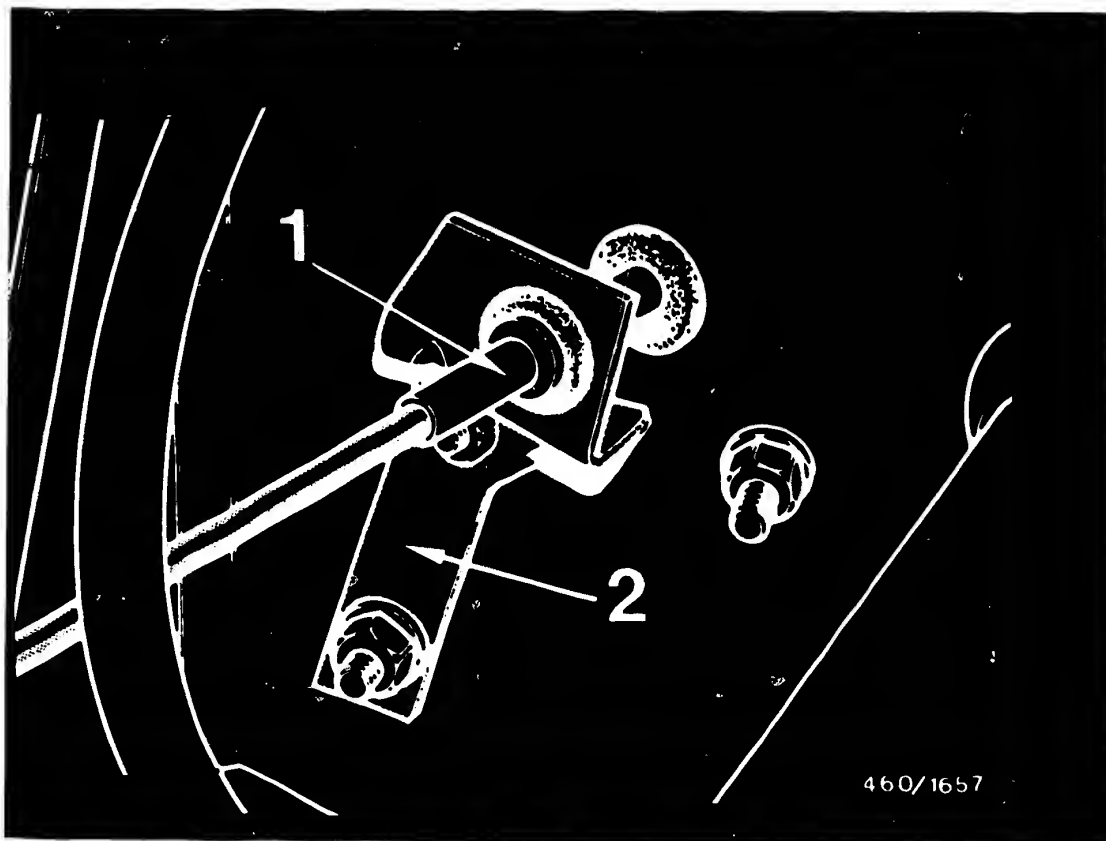
19. Adjust speed control lever

Feed actuating cable through the mounting on the engine and assemble to speed control lever. Push adjusting sleeve into mounting on engine.

**Note:**

Make sure that the steel-sheet clip is seated firmly.





1 = Holding grommet

2 = Mounting

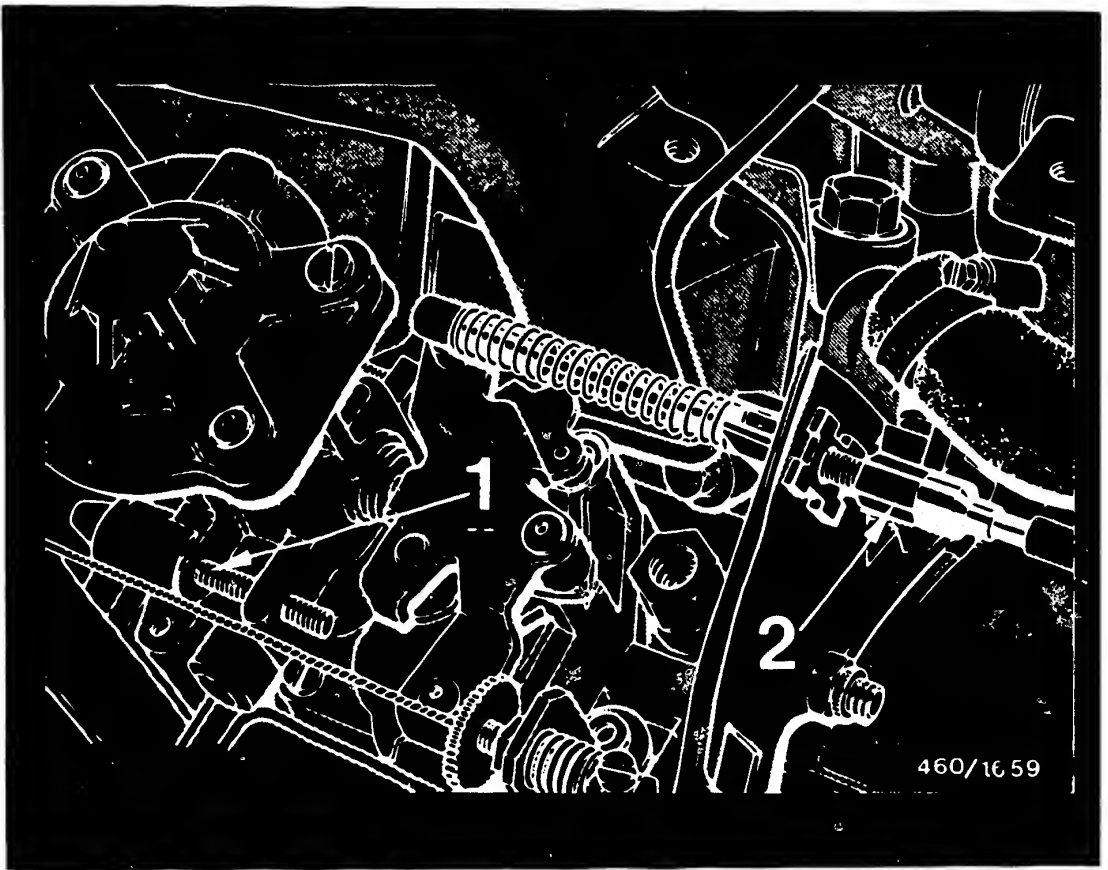
Push holding grommet into the mounting on the end wall. Push actuating cable through grommet and mounting until actuating cable latches in.

**C13**

Adjust speed control lever

Ford





- 1 = Maximum-full-load-speed stop screw  
2 = Adjusting sleeve

Assemble actuating cable onto accelerator pedal.

Push accelerator pedal as far as it will go.

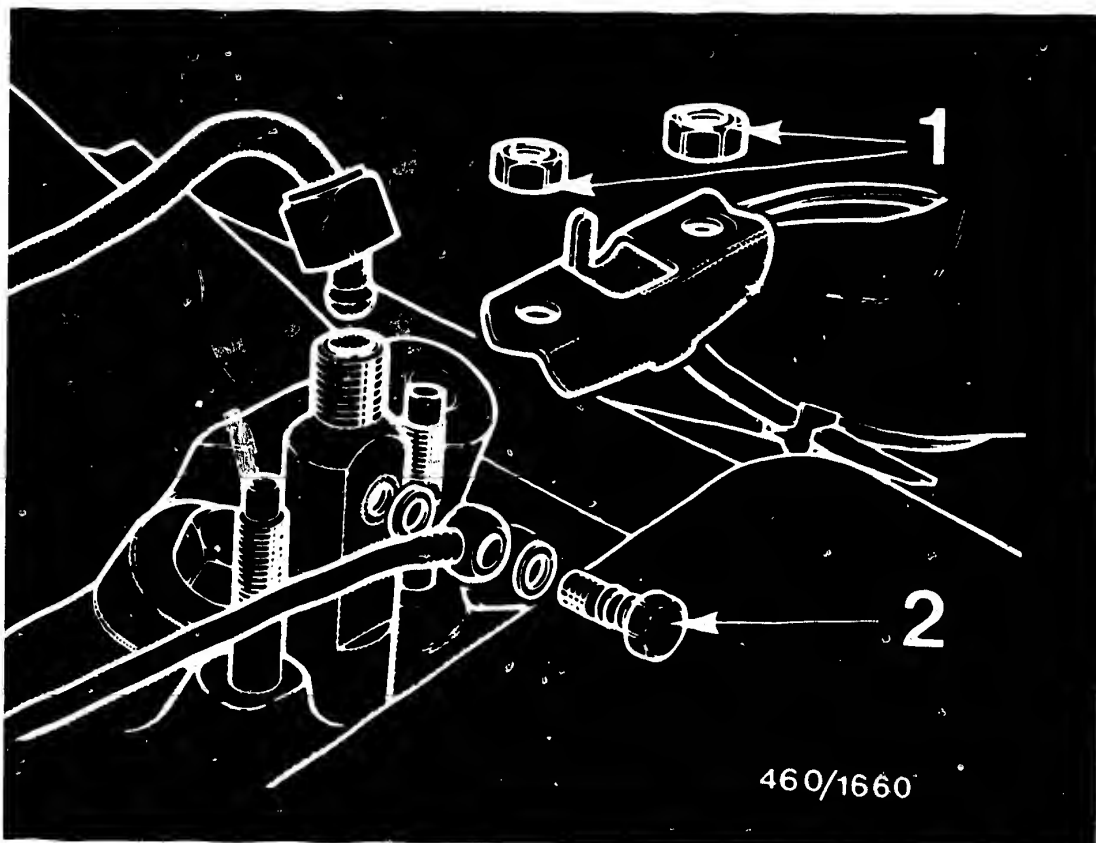
Speed control lever must be in contact with the maximum-full-load-speed stop screw.

Adjust with adjusting sleeve.

Release accelerator pedal.

Check whether speed control lever is in contact with the idle-speed adjusting screw.





- 1 = Fastening screws  
2 = Inlet-union screw

## 20. Remove injection nozzles

Remove inlet-union screw of leak-fuel line from the injection nozzles.

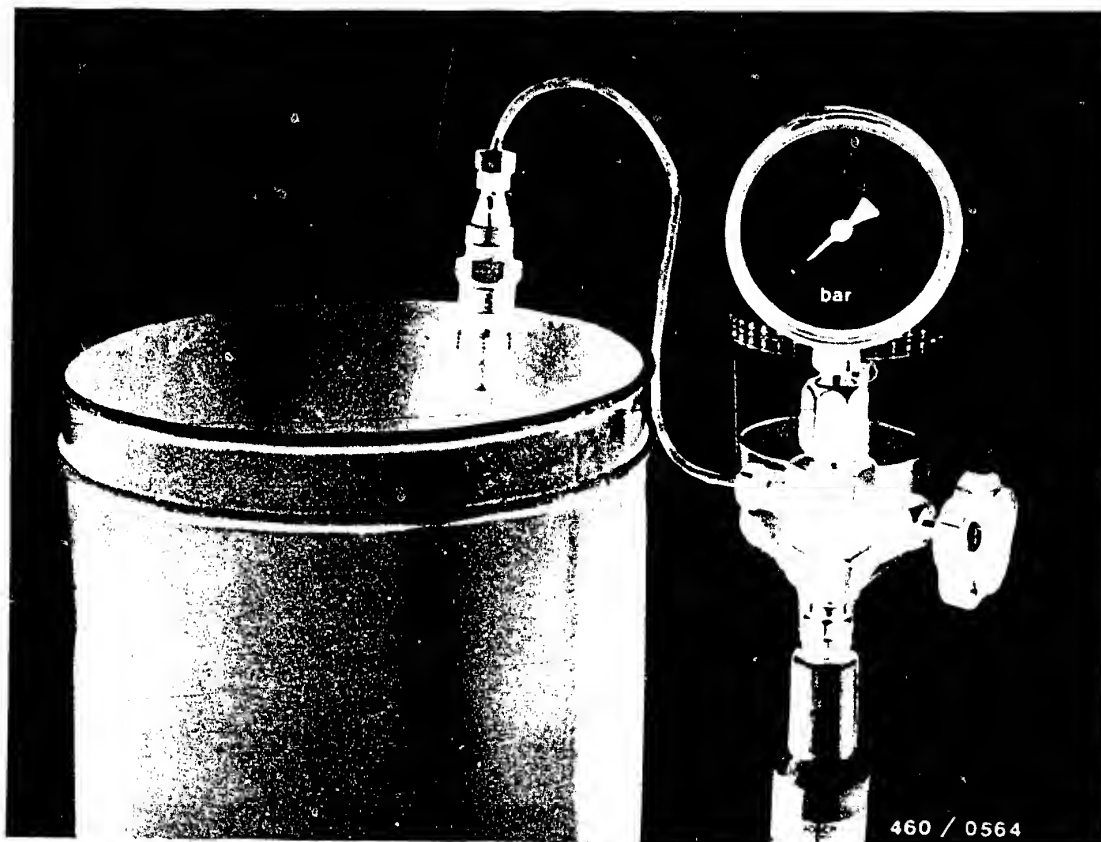
Unscrew fuel-injection tubing.

Remove fastening nuts from clamping plates. Lift off clamping plates.

Pull injection nozzle out of cylinder head.

Remove gasket from the injection nozzle/out of the cylinder head.





### 21. Test injection nozzles

The test is performed using the nozzle tester EFEP 60 H 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on nozzle tester.

To make sure that the nozzle is not under tension, actuate the hand lever of the nozzle tester a number of times, heavily, with pressure gauge switched off (approx. 4 to 6 downward movements/second).





Note:

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.

For testing, use pure calibrating oil to ISO 4113 or clean diesel fuel.

Test criteria:

- Opening pressure
- Leakage
- Chatter
- Spray pattern

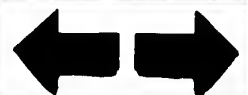
21.1 Test injection pressure

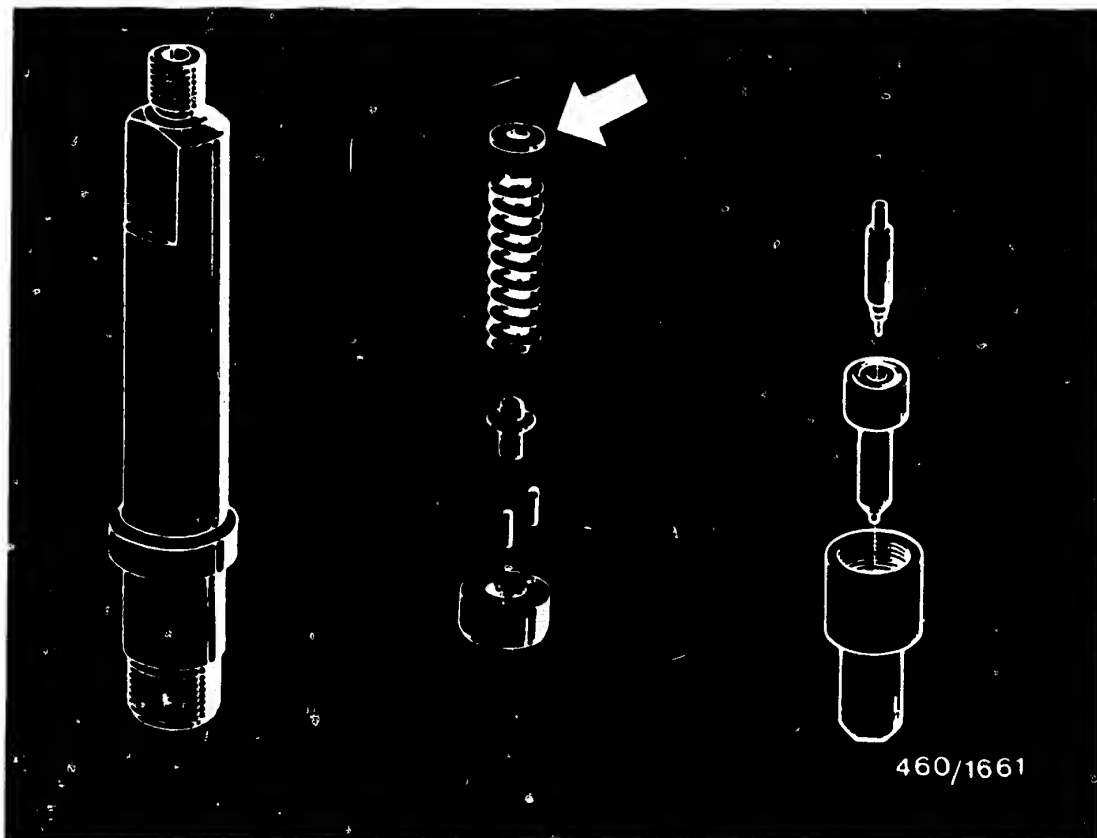
Open injection valve at pressure gauge approx. 1/4 rotation.

Slowly push down hand lever of nozzle tester (pressure rise at pressure gauge).

Observe at which pressure the indicator of the pressure gauge remains constant (nozzle does not chatter), or when the pressure suddenly drops (nozzle chatters).

The highest pressure obtained in this test is the opening pressure.





If different from the set value, correct the nozzle-opening pressure by means of shims behind the pressure spring (arrow).

Set value:

Opening pressure (new nozzles)	250 + 8 bar
Opening pressure (used nozzles)	250 ± 5 bar

Thicker shims = higher nozzle-opening pressure

Thinner shims = lower nozzle-opening pressure.

A +/- 0.05 mm change of the spring travel results in a change of nozzle-opening pressure of approx. 5 bar.



## 21.2 Leak test

Open shutoff valve at pressure gauge by approx. 1/4 rotation.

Dry off lower part of nozzle and of nozzle-holder assembly (blow dry with air).

Slowly press hand lever downward until the pressure gauge indicates 20 bar less than the opening pressure previously read off. The nozzle is leakproof if no drop falls from the mouth of the nozzle within 10 seconds.

If a drop falls, dismantle nozzle-and-holder assembly and clean.

If there is still a leakage, replace nozzle.  
Remachining of nozzle components is not permissible.

### Note:

Scoring on the supporting device and washer may be remachined taking great care (except during the warranty period).



### 21.3 Chatter test, assessment of spray pattern

#### General:

When assessing the nozzles, it is necessary to differentiate between new and used nozzles.

Switch off pressure gauge.

#### New nozzles:

The chatter test involves audibly testing the freedom of movement of the nozzle needle in the nozzle-holder assembly.

If the nozzle chatters despite being cleaned, replace with a new nozzle. The spray pattern is irrelevant with regard to the chatter test. A spray pattern in accord with the specification is available generally only with new nozzles.

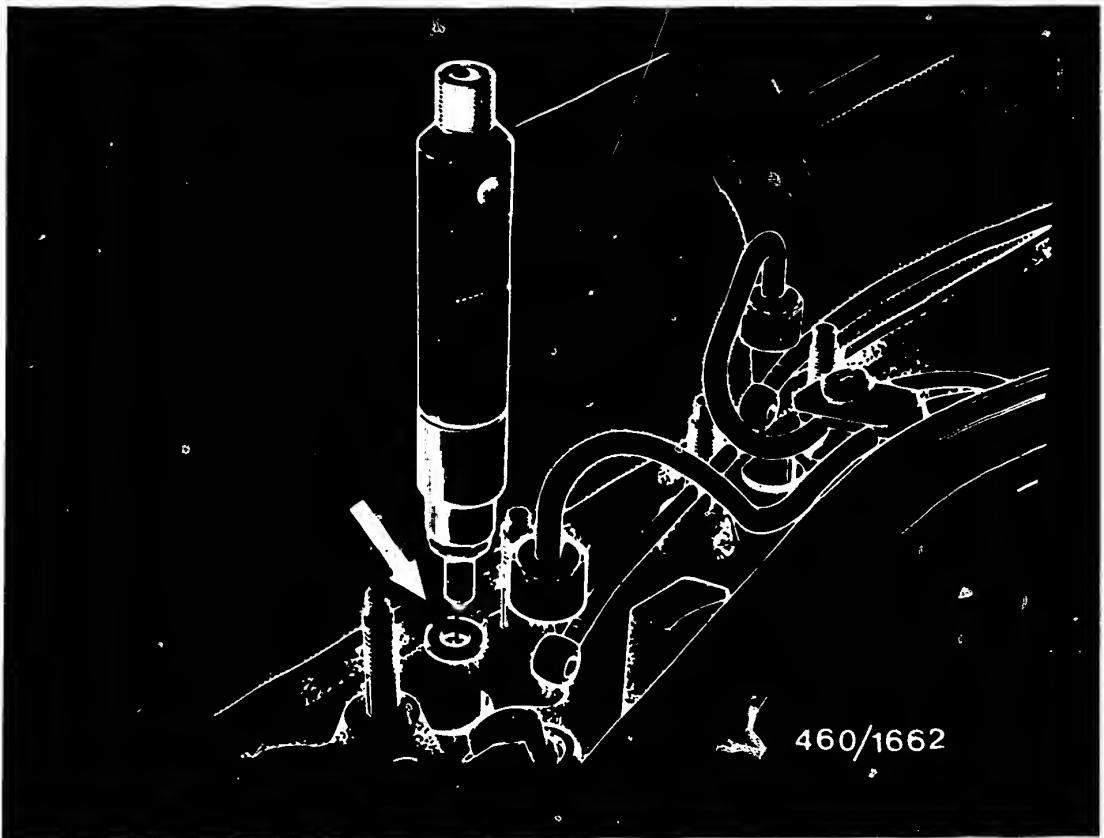
#### Used nozzles:

The chatter characteristics of the nozzle deteriorate if there is wear around the area in which it is seated. The nozzle must chatter audibly and/or spray with good atomization when the lever is actuated rapidly.

The spray pattern of used nozzles may deviate from the ideal pattern of a new nozzle.

However, the spray pattern of such nozzles may be noticeably improved by taking suitable cleaning measures.





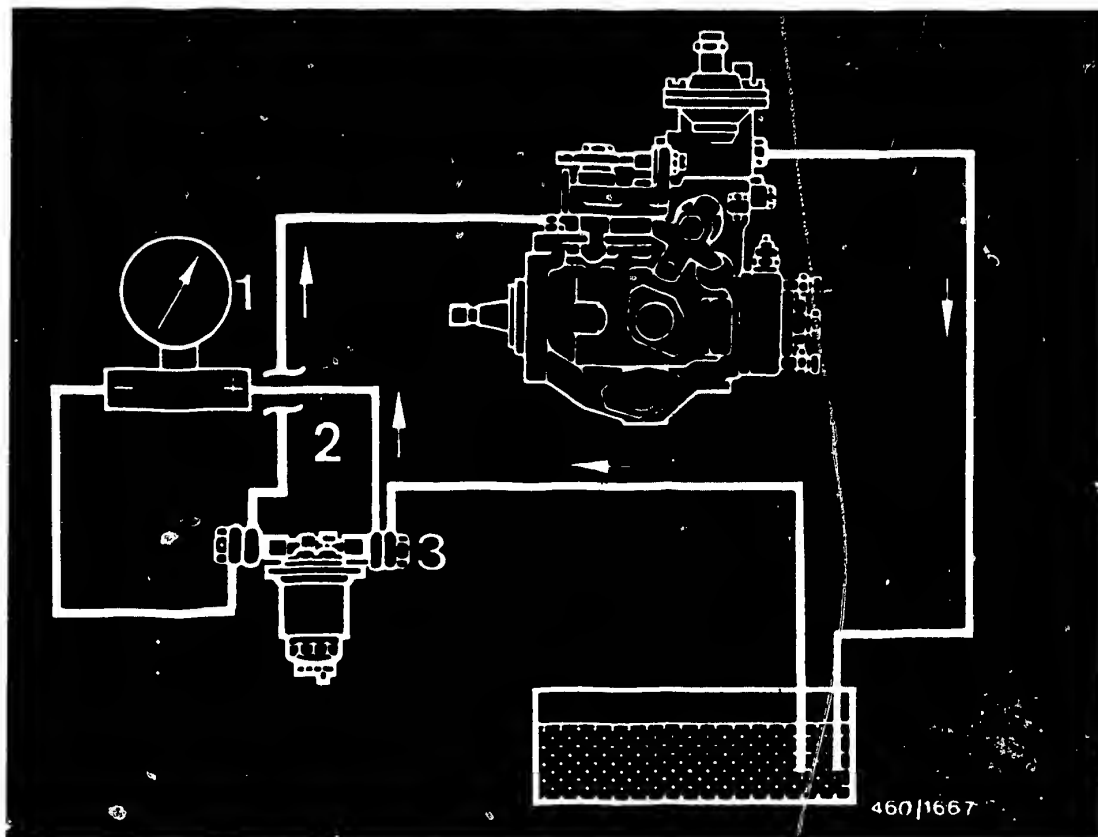
## 22. Install injection nozzles

Fit new gasket to nozzle (arrow). Insert injection nozzle into cylinder head in such a way that the connection for the leak-fuel line points toward the cylinder-head cover.

Position clamping plates in such a way that the lug points toward the intake manifold.

Tightening torque of fastening nuts: 12 - 15 Nm.





- 1 = Differential-pressure gauge
- 2 = Filter outlet (use inlet union and extra-long inlet-union screw 2 443 456 020).
- 3 = Filter inlet (use inlet union and extra-long inlet-union screw 2 443 456 020)

### 23. Check fuel filter (differential-pressure test)

Connect differential-pressure gauge to fuel filter using appropriate connecting pieces.





Connect the (+) side of the differential-pressure gauge to the fuel filter inlet. Fit the (-) connection of the pressure gauge to the filter outlet. See connection diagram.

Run engine until you are sure that there is no air in the fuel system.



Move injection-pump control lever briskly ( approx. 1 sec) from the idle stop to the maximum-speed stop.

Release control lever and read off differential pressure on pressure gauge.

The differential pressure may be max. 0.3 bar. If this value is exceeded, replace filter. Remove test connections.

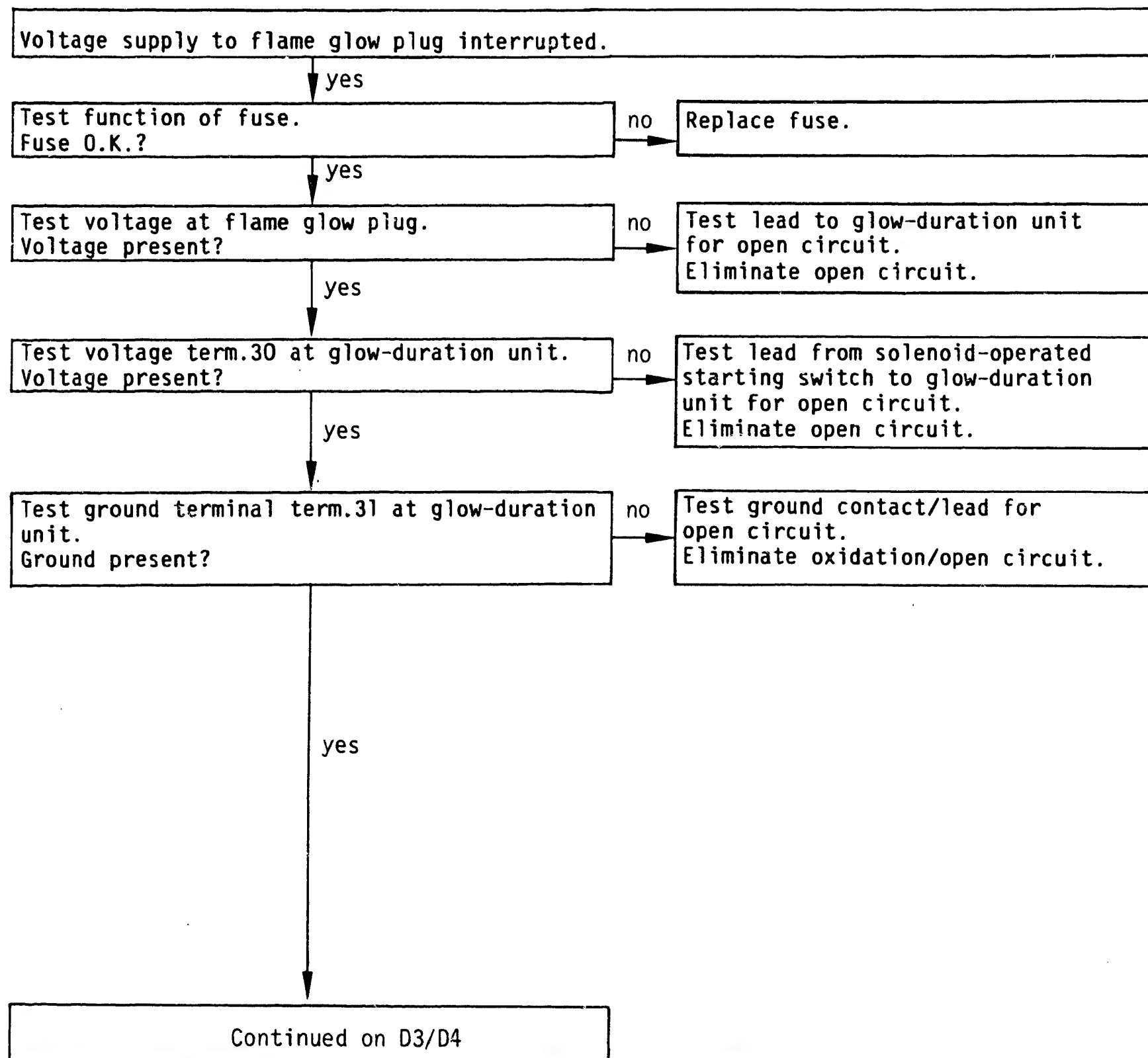
If necessary, bleed fuel system.





## 24. Test flame starting system

Symptom of trouble: engine fails to start.



**D1**

Test flame starting system

Ford

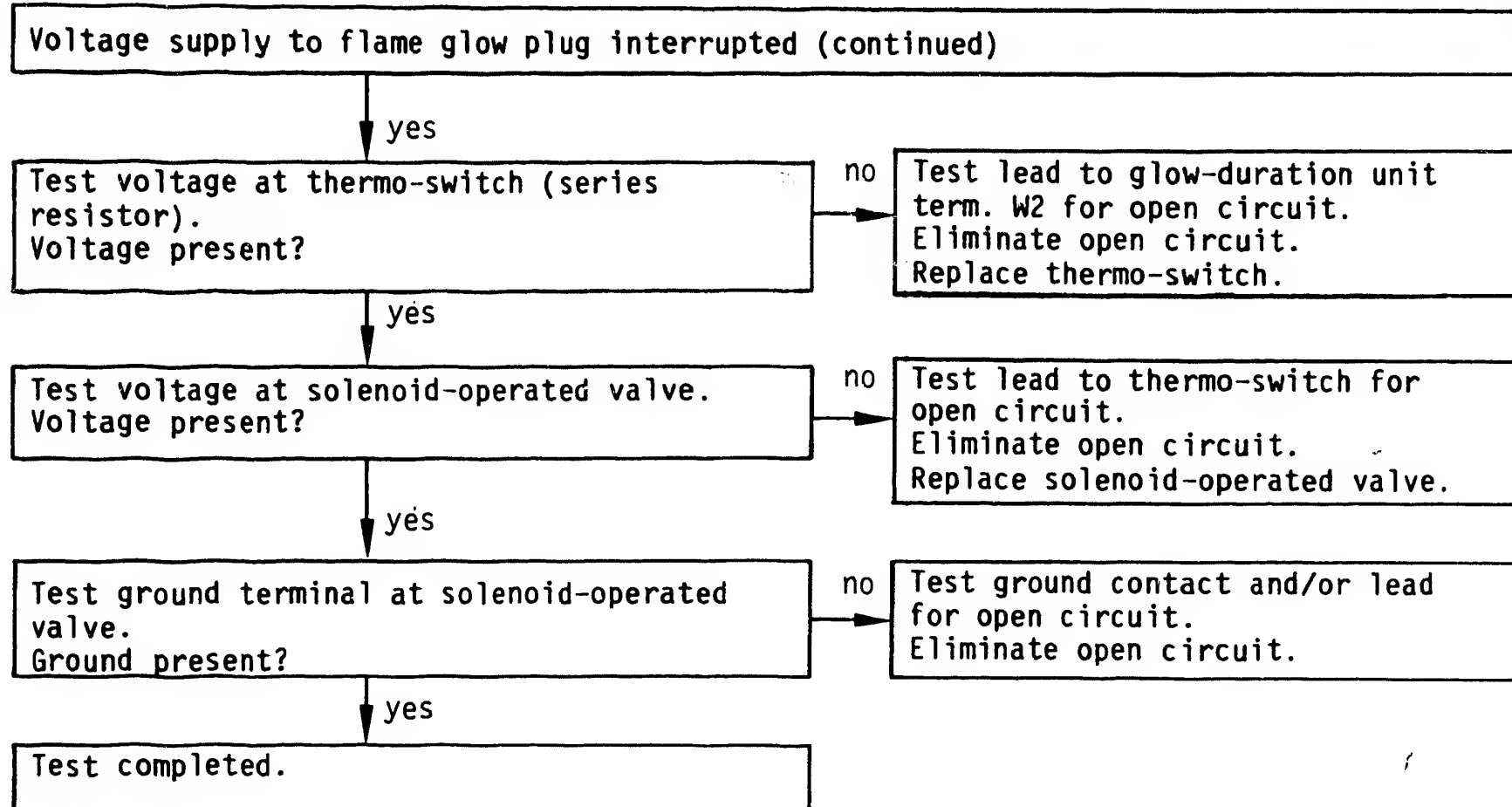


**D2**

Test flame starting system

Ford





D3

Test flame starting system

Ford

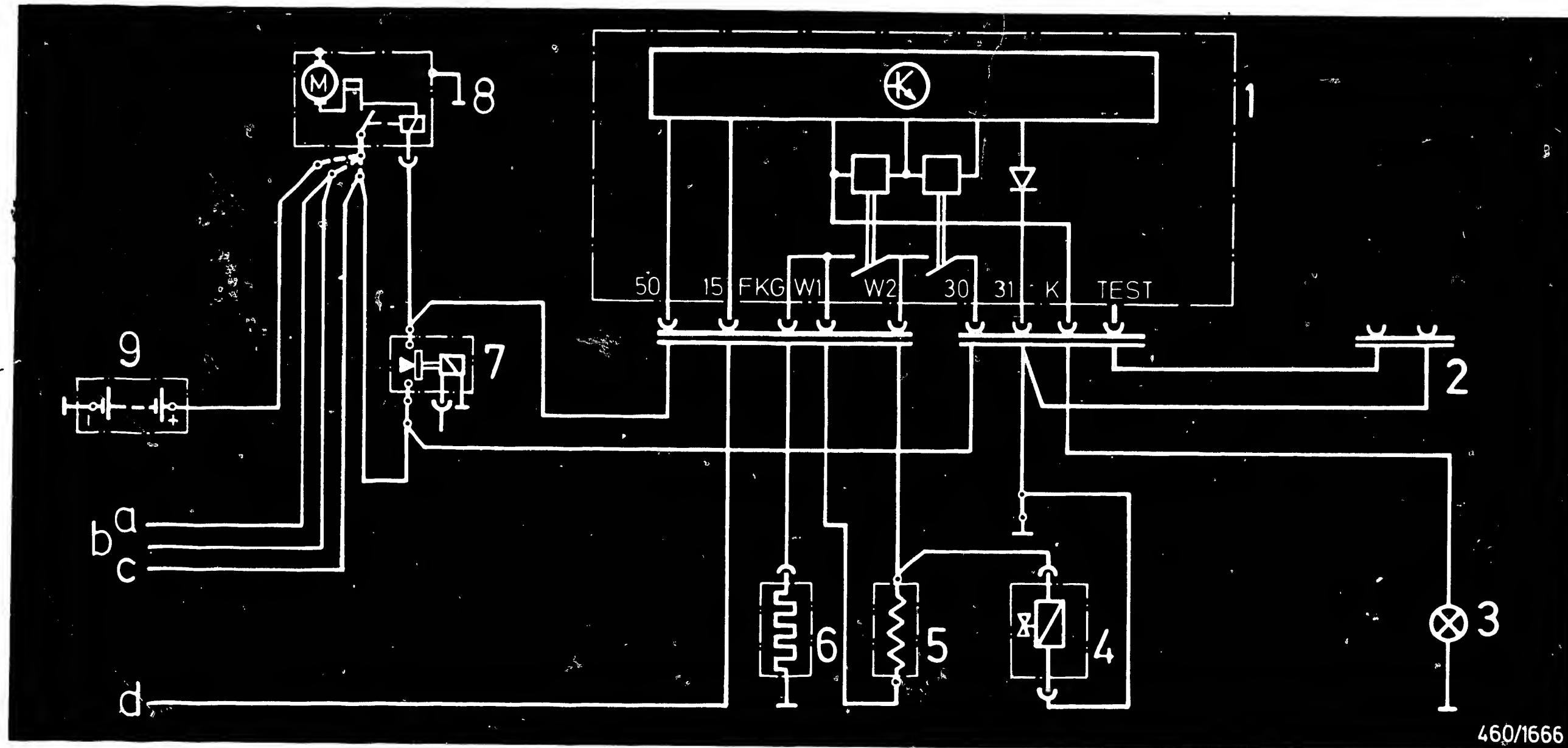


D4

Test flame starting system

Ford





### 24.1 Terminal diagram, flame starting system (non-Bosch equipment)

- 1 = Glow-duration unit  
2 = Test plug, cold start  
3 = Control lamp  
4 = Solenoid-operated fuel valve  
5 = Series resistor, flame glow plug

- 6 = Flame glow plug  
7 = Solenoid-operated starting switch  
8 = Starting motor  
9 = Battery

- a = Plug-in connection  
b = Alternator  
c = Alternator  
d = Plug-in connection



## 25. Check timing device

In distributor-type fuel-injection pumps VE..F.. the timing device is integral with the fuel-injection pump.

In order to test the timing device, it is necessary to remove the fuel-injection pump.

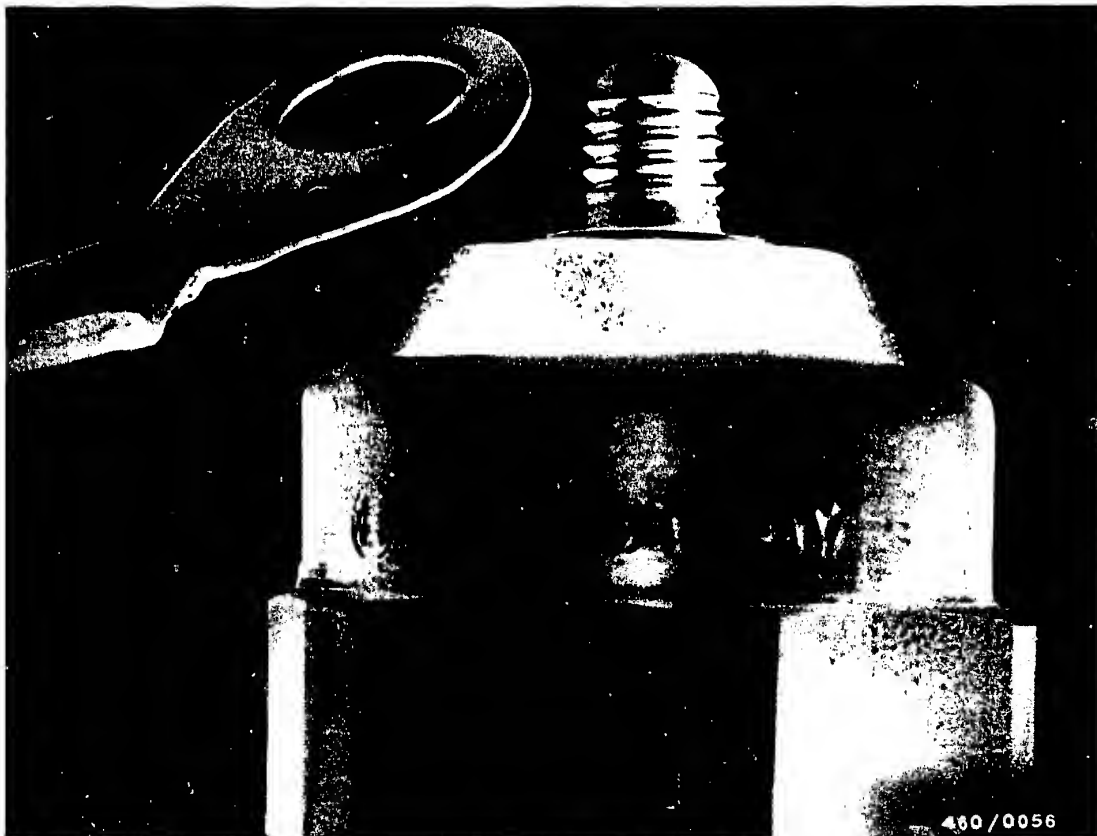
Perform the test on the injection-pump test bench.

**D7**

Check timing device

Ford





## 26. Measure engine compression and compression loss

### 26.1 Measure engine compression

Fit new chart in compression tracer. Mount high-pressure hose on tracer. Switch off engine.

In order to prevent fuel from being injected, remove connecting cable from shutoff magnet on distributor-type fuel-injection pump (picture).



Remove all sheathed-element glow plugs.

With the aid of the starting motor turn the engine over several times so that loose deposits are removed from the compression chamber.

Screw in connecting piece into the respective threaded hole.

Mount high-pressure hose of compression tester on connecting piece.

Note:

The compression is tested at normal operating temperature (approx. 80°C coolant temperature).



During the following operation, pay particular attention to the first compression stroke.

Operate starting motor until there is no longer any detectable pressure rise on the compression tracer.

Bleed compression tracer by pressing on bleed valve.

The pointer returns to the starting position.

Move chart into next position.

Mount connecting piece onto following cylinders and repeat measurement.

Set value: 33.8 bar.



## 26.1.1 Evaluation of chart

### 1. Normal pressure rise

If piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.

During the following compression strokes, the compression builds up to the maximum pressure.

### 2. Gradual pressure rise

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

### 3. Low maximum pressure

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.

If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder head gasket.





#### 4. Varying compression

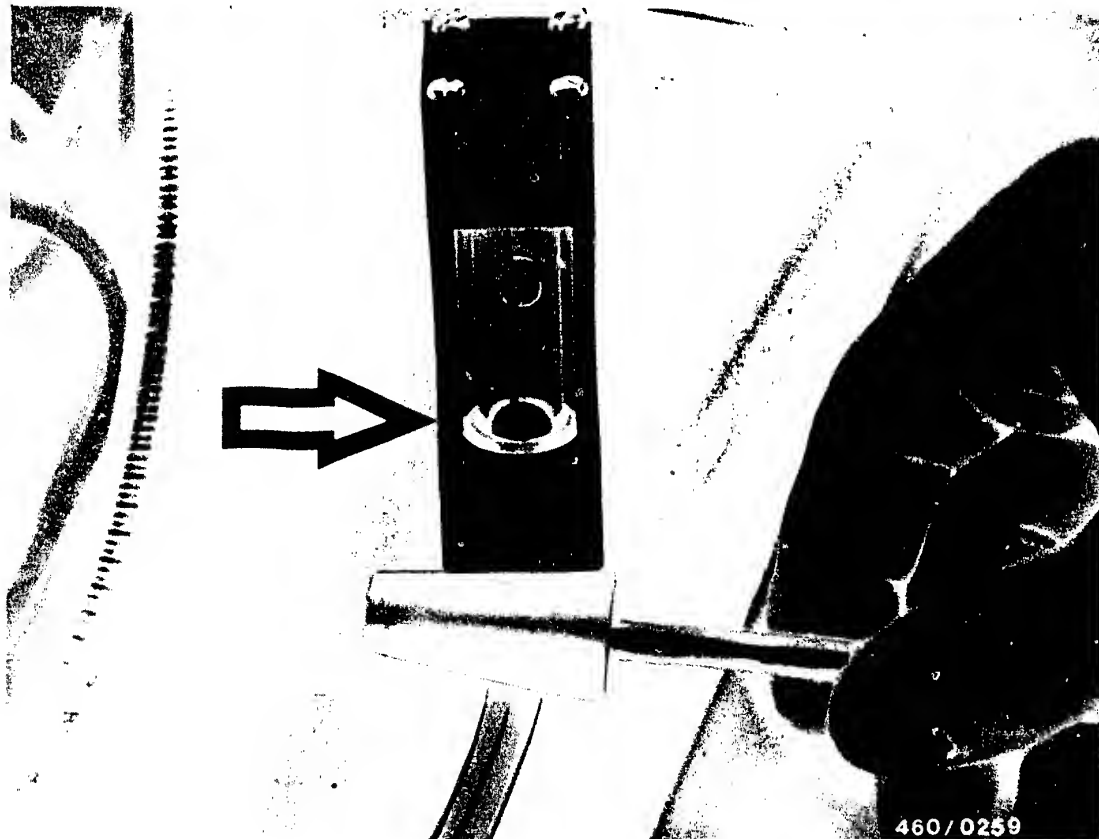
If one cylinder shows a clearly lower compression, proceed as follows: fill in 2-3 cm<sup>3</sup> of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate starting motor briefly.

Repeat measurements and compare charts. If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn. If there is no change in the result, then defective valves are the cause.

#### 5. Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine. Maximum compression is, therefore, not the only objective.





## 26.2 Measure compression loss of engine

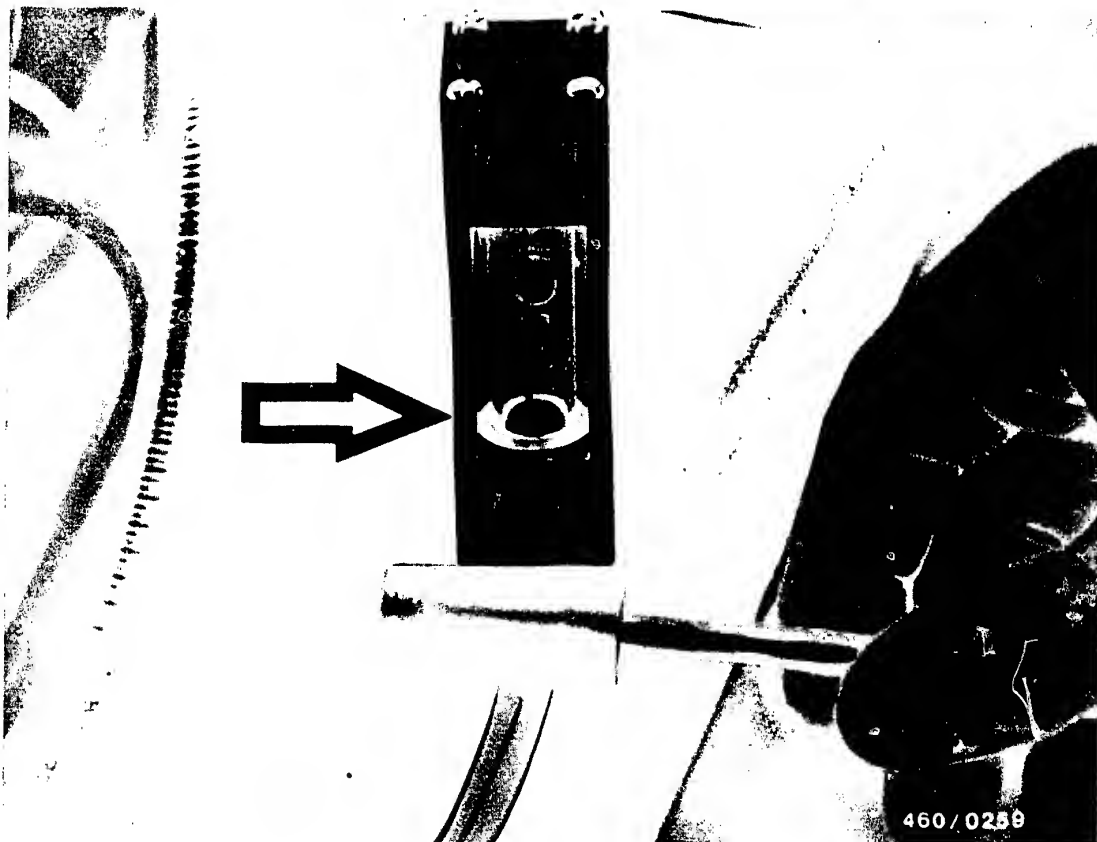
The test is performed using the Bosch compression-loss tester 0 681 001 901 (EFAW 210 A).

For testing, the respective piston must be at TDC (TDC = top dead centre) on the compression stroke.

For setting this position, use DC detector 1 688 132 025 (included in accessories with compression-loss tester).

Perform test with engine at normal operating temperature (temperature of water approx. 80 °C).





### 26.2.1 Set top dead centre

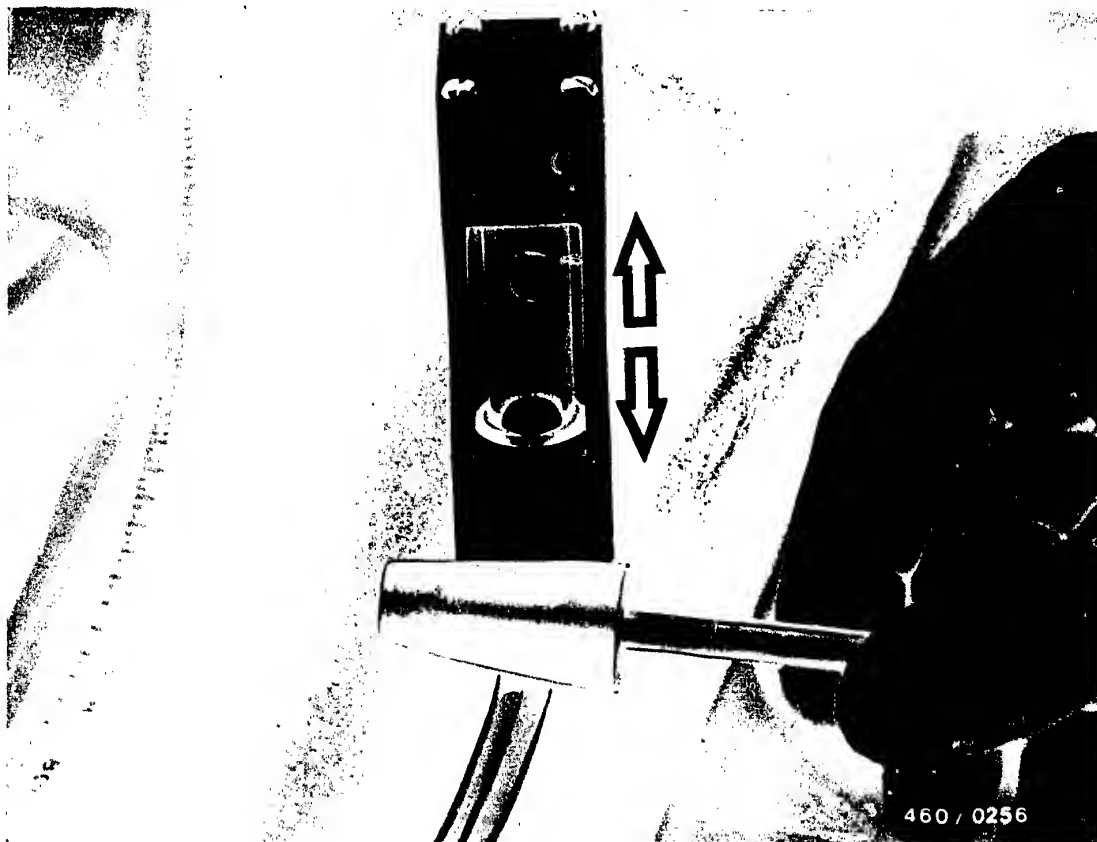
Remove sheathed-element glow plug from cylinder 1.

Insert rubber plug of DC detector into bore for sheathed-element glow plug.

Using magnetic clamp, mount glass cylinder in as vertical a position as possible in the engine compartment. The piston of the unit must be easily visible.

Slowly turn over engine (crankshaft) by hand in direction of engine rotation. (If necessary, select gear and push vehicle).



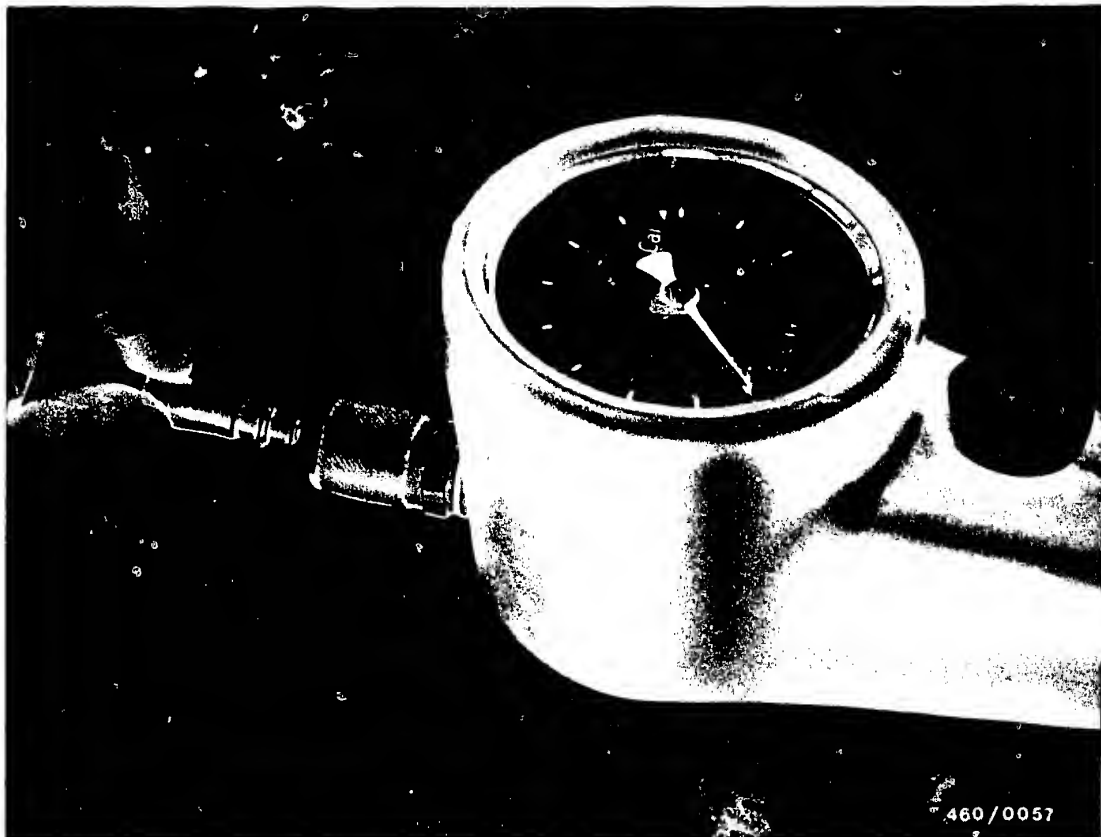


On the compression stroke, the piston of the DC detector is forced upwards.

As top dead centre is passed over, the piston slides down again immediately.

Find top dead centre by carefully turning the engine backward and forward.





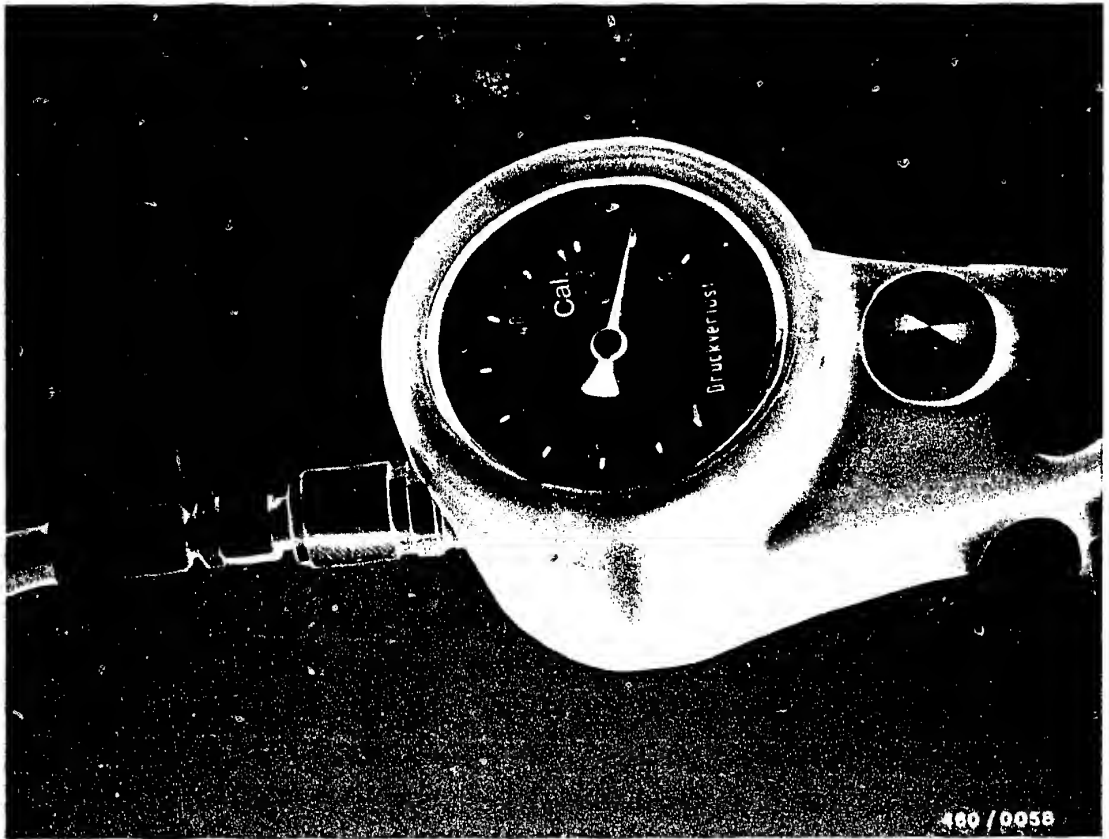
### 26.2.2 Measure compression loss

Connect tester to compressed-air mains.

Connect calibrating nozzle 1 680 363 036. Set a compression loss of  $23 \pm 1\%$  (marking "Cal".) at the knurled thumbscrew on the pressure-regulating valve. Disconnect calibrating nozzle.

(Instrument indicator must show approximately 0% compression loss - equipment check.)





Screw in fitting and mount test hose.  
Select gear and pull on handbrake.  
Connect test hose to tester.  
Read off compression loss in % on instrument.

Note:

Before testing the next cylinder, turn the engine over briefly without pre-heating using the starting motor so that the oil film re-forms.

Firing sequence 1 - 3 - 4 - 2.



### 26.2.3 Evaluation of test

The compression loss indicated should not exceed 25%.

Differences of 10% between the individual cylinders can be ignored.

The causes of greater losses can be located because the air makes a noise as it escapes.

Listen at the following points:

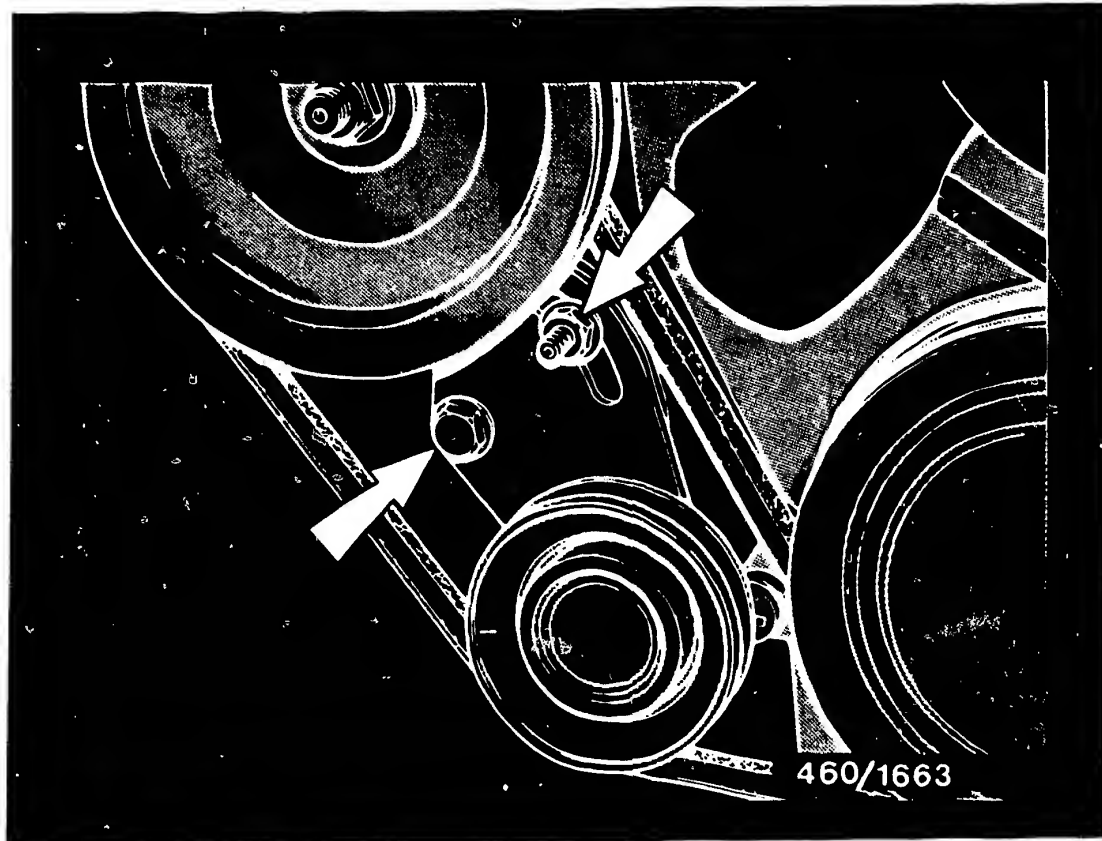
<u>Location of noise</u>	<u>Possible trouble</u>
Intake manifold (remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons, piston rings
Cooling water filler neck (air bubbles)	Cylinder head gasket

In order to trace the trouble even more accurately, fill approximately 2-3 cm<sup>3</sup> of engine oil into the cylinder. Repeat test.

If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5,000 km) may show higher compression losses than after the running-in period.





27. Remove fuel-injection pump  
Disconnect negative cable from battery.

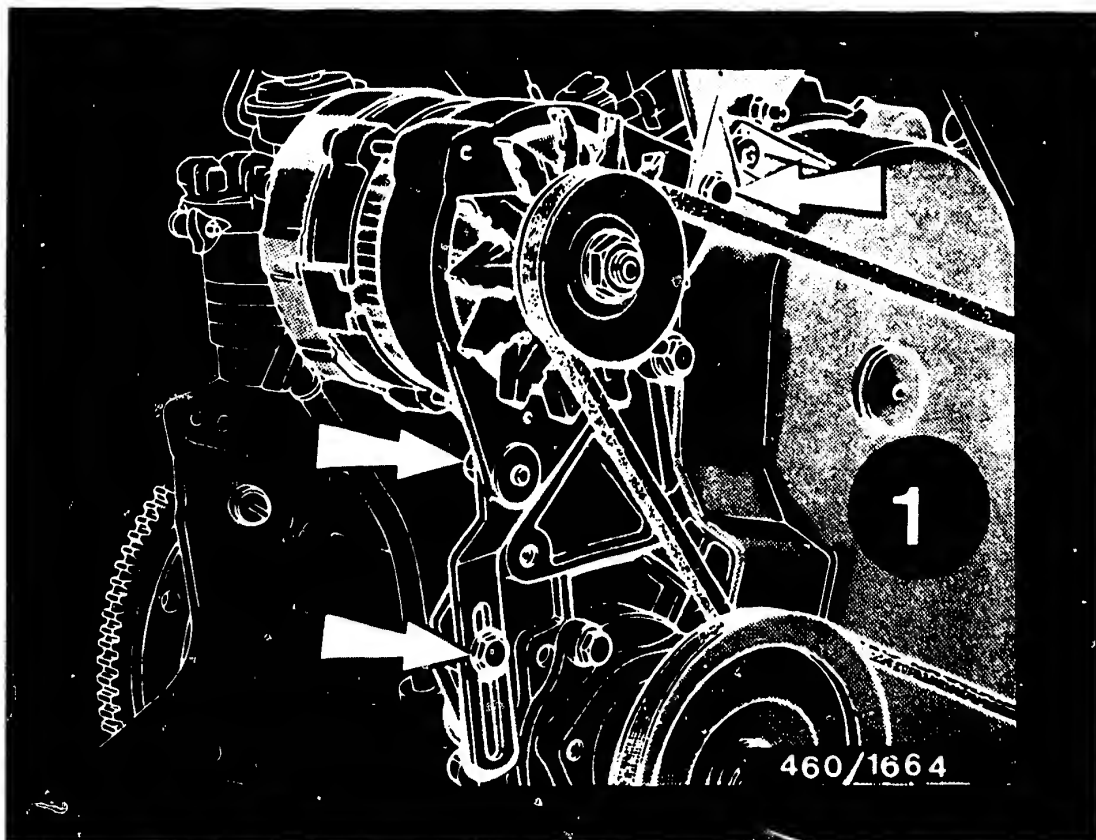
Remove radiator grid.  
Drain coolant and remove radiator.

Loosen nut on viscous fan and remove fan from the  
water-pump shaft.

Unscrew water-pump pulley from water-pump flange (four  
bolts) and remove.  
Loosen clamping fixture of V-belt (arrows) and remove  
belt.



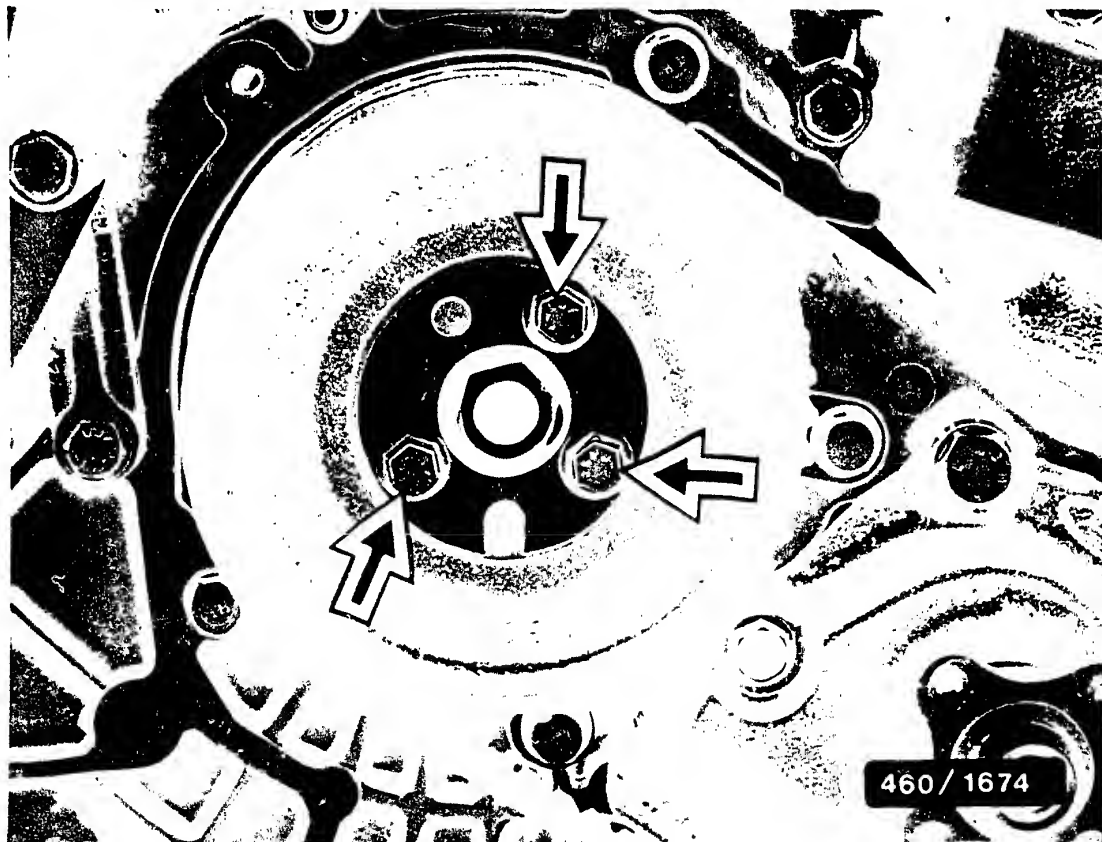




1 = Cylindrical-gear cover

Loosen fastening screws used for adjusting the alternator (arrows) and lift off V-belt. Unscrew cylindrical-gear cover (1).





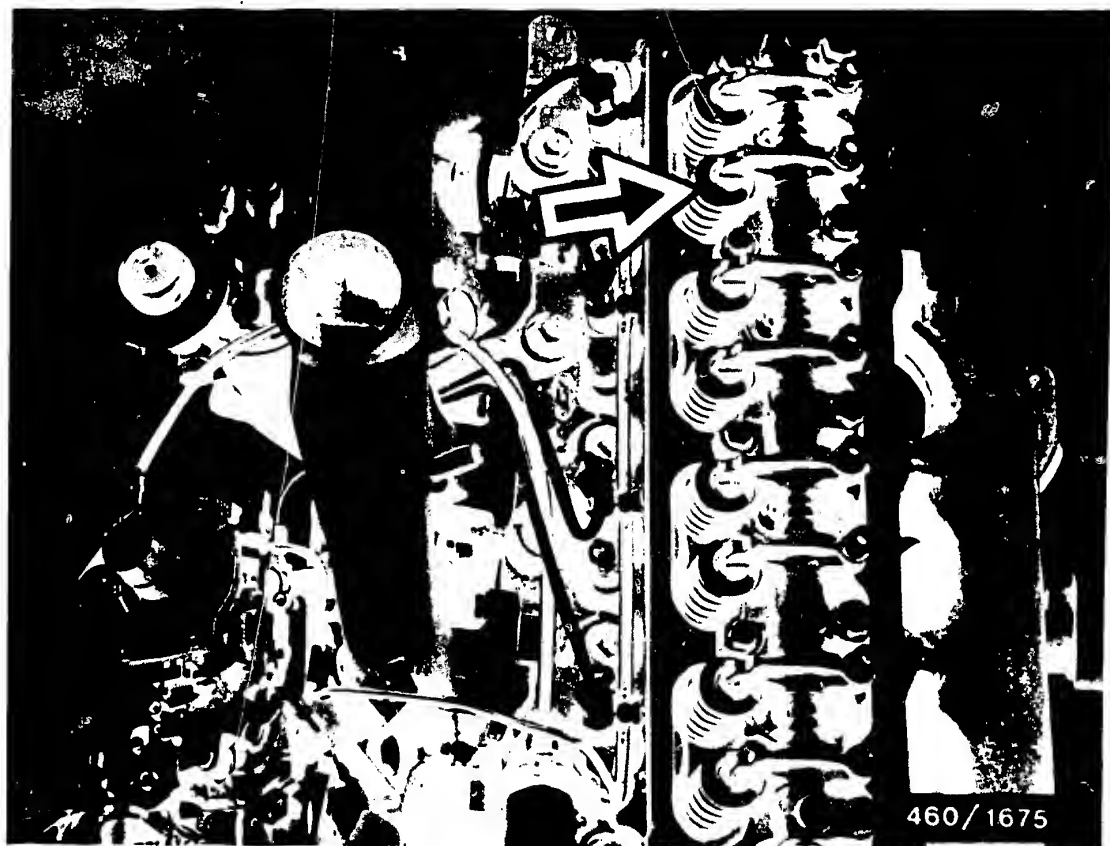
Loosen fastening screws of injection-pump driving gear (arrows).

**D21**

Remove fuel-injection pump

Ford



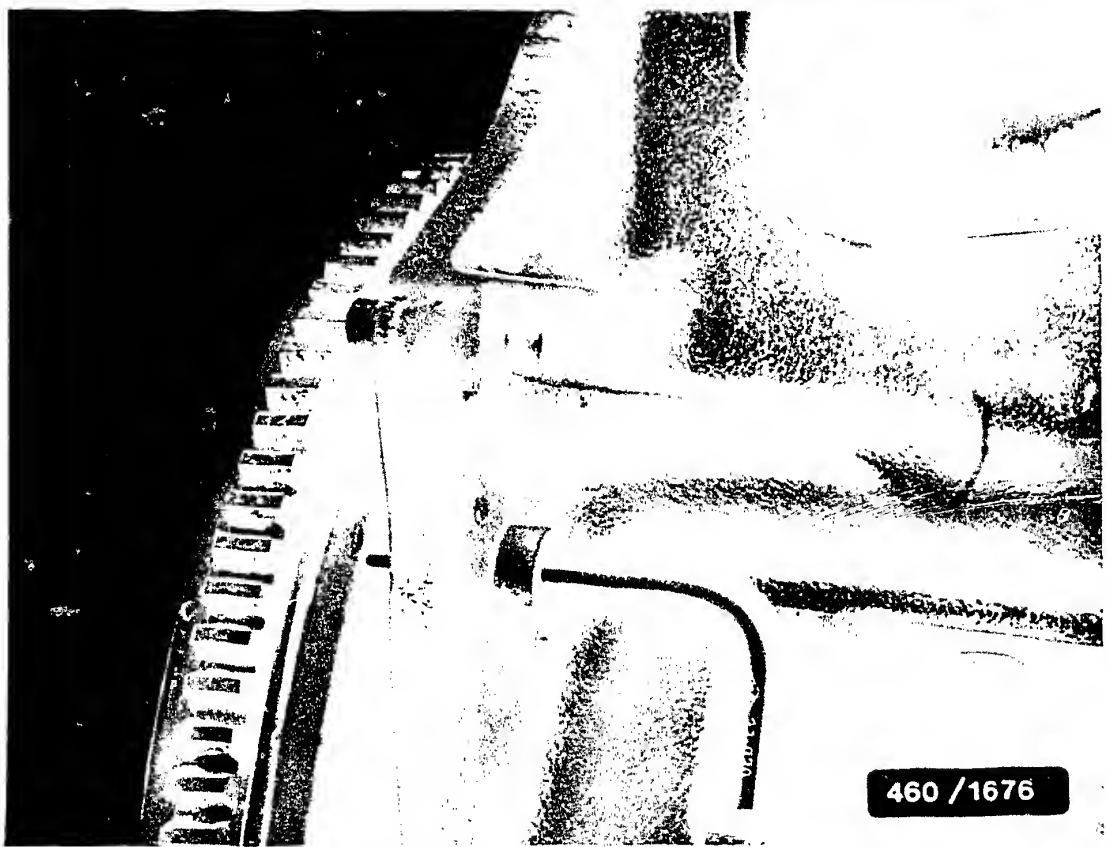


Unscrew cylinder-head cover and remove.

Set engine piston of cylinder 1 to 11° before TDC.

Exhaust valve, cylinder 4 - arrow - begins to close.



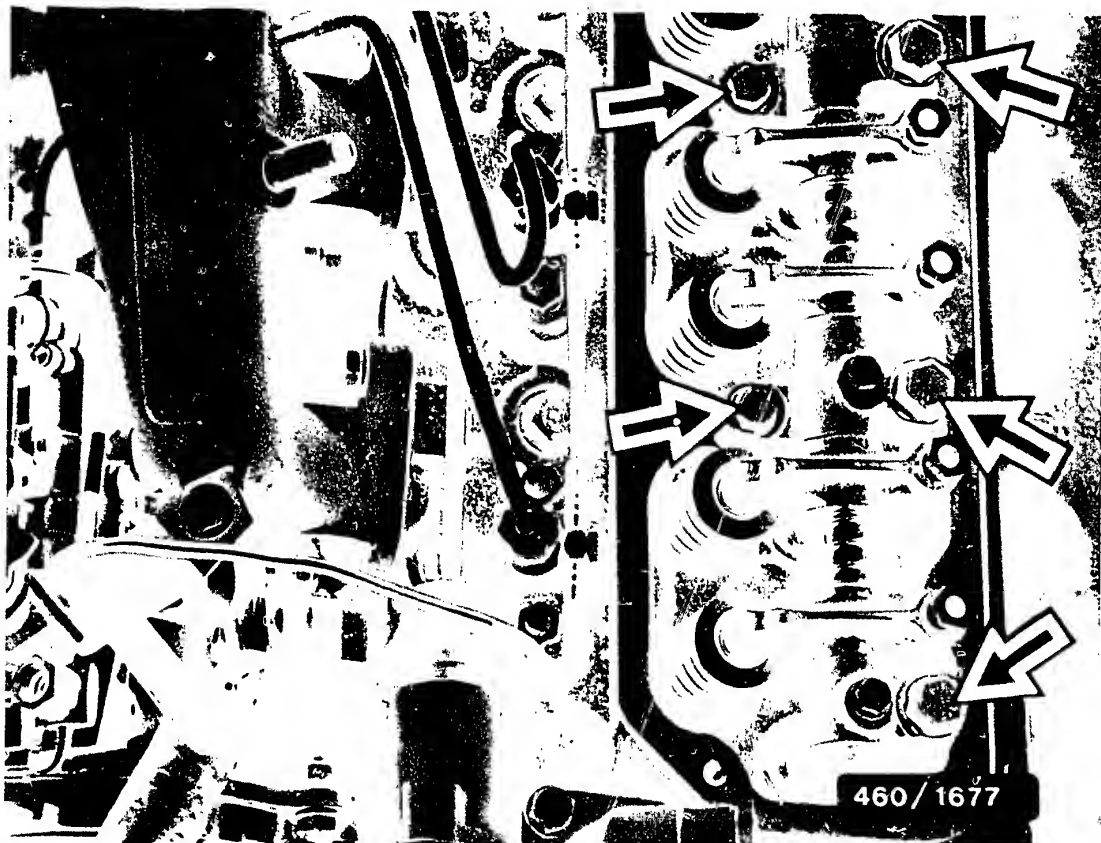


Remove plastic plug from the setting bore at the rear in the cylinder block near to engine nameplate.

Insert setting pin KDEP 1161/3 into setting bore and press against it lightly.

Turn crankshaft in direction of engine rotation until pin slips into the bore of the flywheel.





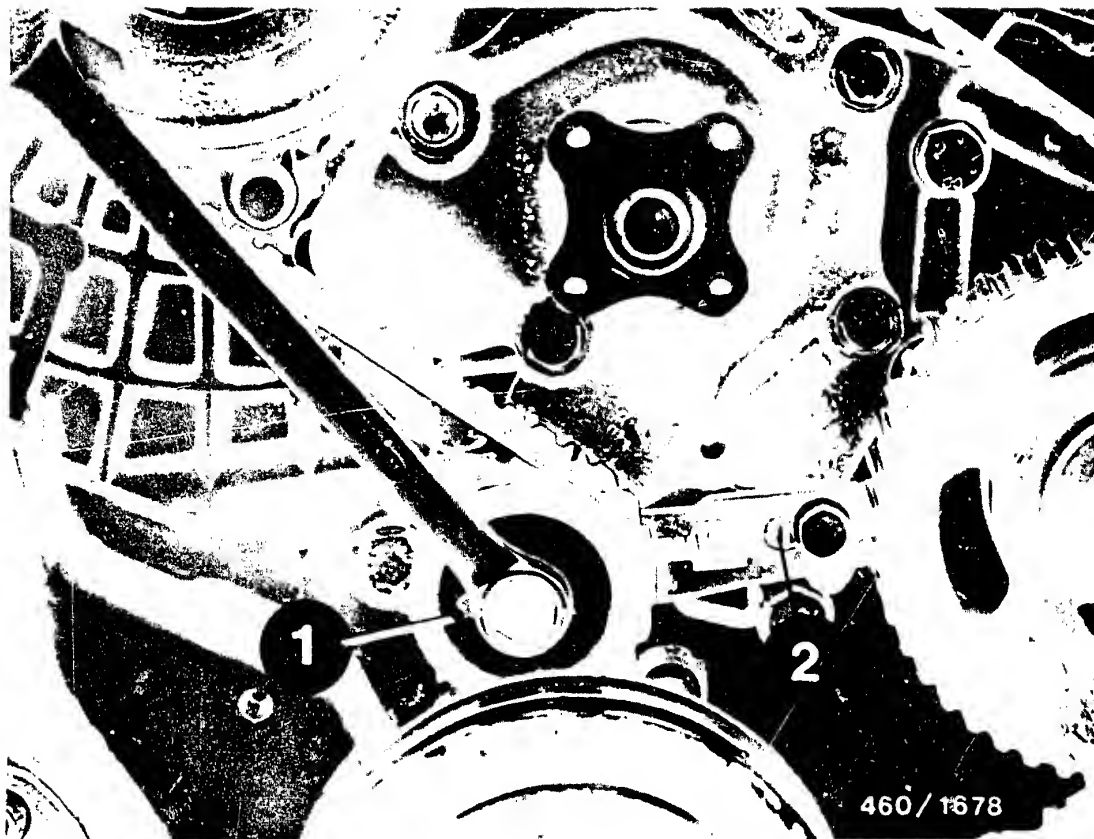
Remove rocker-arm shaft.

Note:

Removing the rocker-arm shaft prevents the torque generated by the valve springs from being transmitted to the toothed belt via the camshaft gear and thus prevents the belt tension and start of delivery from being impermissibly changed.

Loosen fastening screws (arrows) and remove rocker-arm shaft.





1 = Belt tensioning roller

2 = Belt-adjustment link on end cover

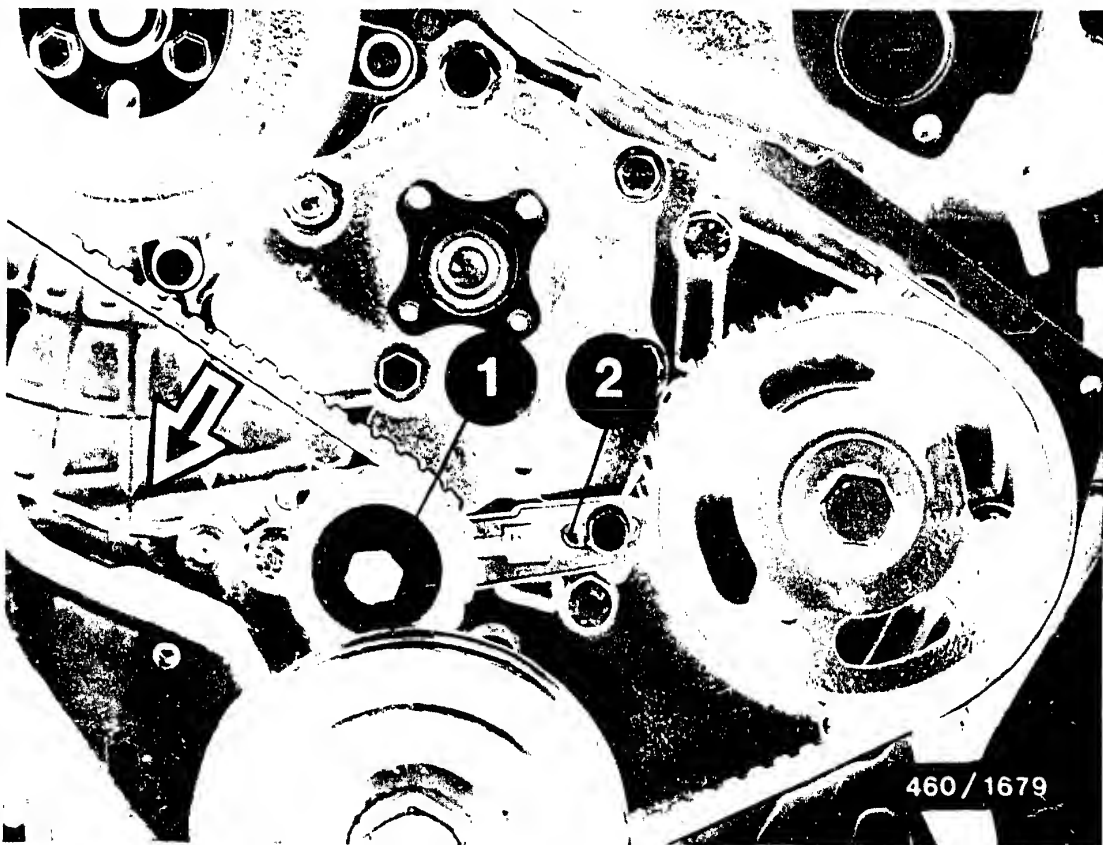
Loosen fastening screw of belt tensioning roller and fastening screw of belt-adjustment link on end cover.

**E1**

Remove fuel-injection pump

Ford





- 1 = Belt tensioning roller  
2 = Belt-adjustment link

Push belt tensioning roller in direction of arrow and tighten belt tensioning roller and belt-adjustment link in this position.

Remove toothed belt.



Remove fuel-supply line, fuel return line, bowden cable from control lever, electric lead from shutoff solenoid and hydraulic cold-start injection advance and fuel-injection tubing from injection pump.

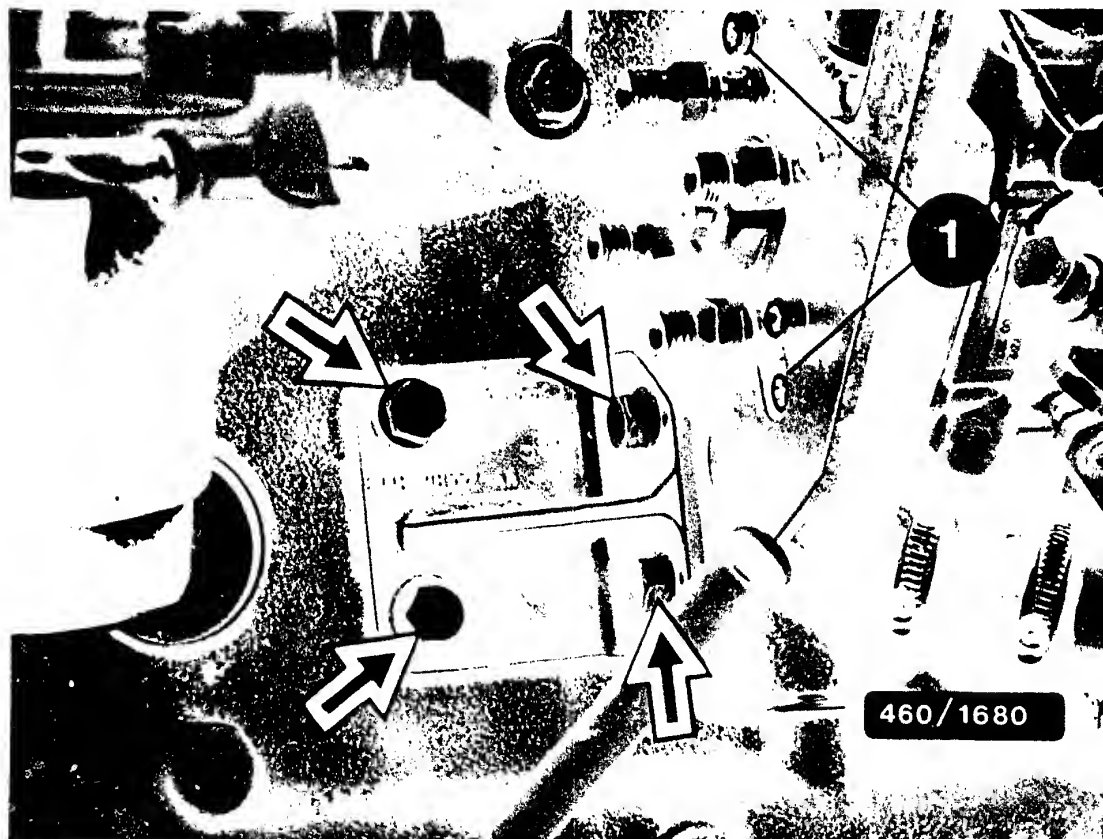
**E3**

Remove fuel-injection pump

Ford







1 = Torx socket screws

Remove fastening screws from bracket (arrows) of distributor head.

Remove bracket.

Note:

Never loosen the torques socket screws; these are the fastening screws for the distributor head.

**E4**

Remove fuel-injection pump

Ford





Remove fuel-injection-pump driving gear.

Loosen fastening screws of injection pump (arrows) and remove carefully.

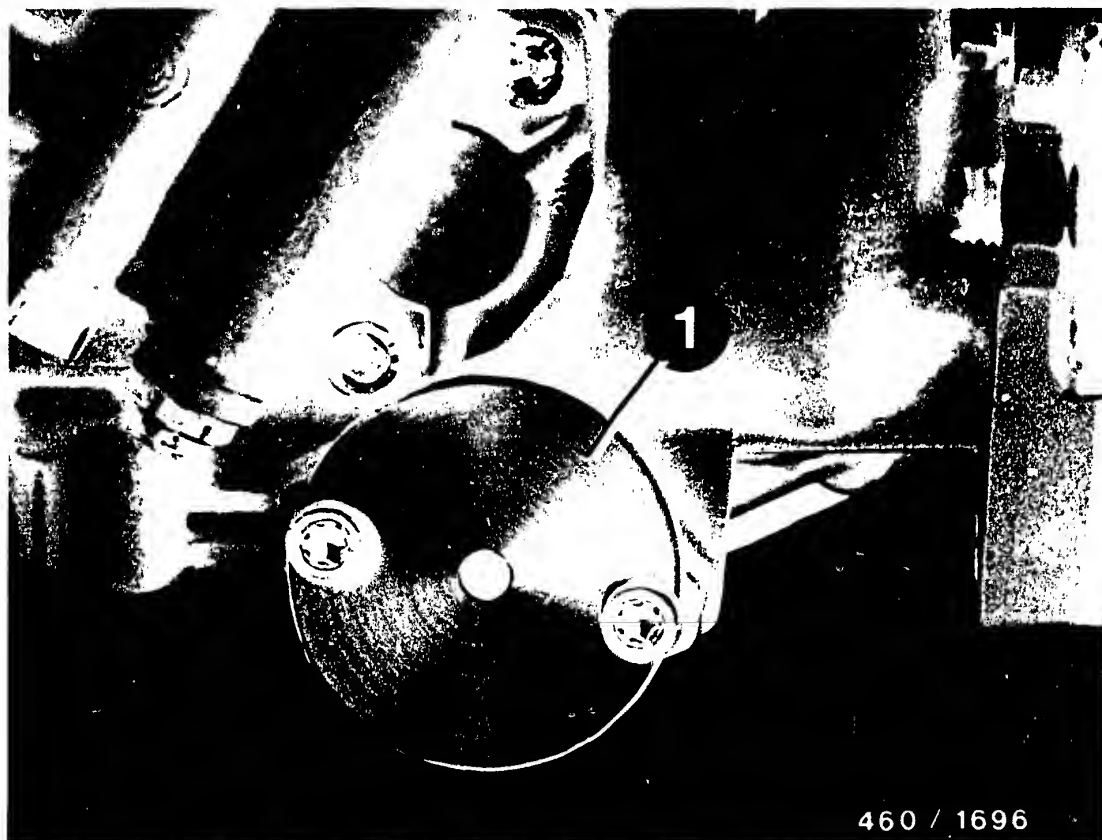
Take out injection pump.

**E5**

Remove fuel-injection pump

Ford





460 / 1696

1 = Timing-device cover

28. Install fuel-injection pump

Before installing the fuel-injection pump, set the start of delivery in accordance with the plunger lift.

Remove timing-device cover at the pressure side.  
Mount timing-device cover KDEP 1151 on pressure side.

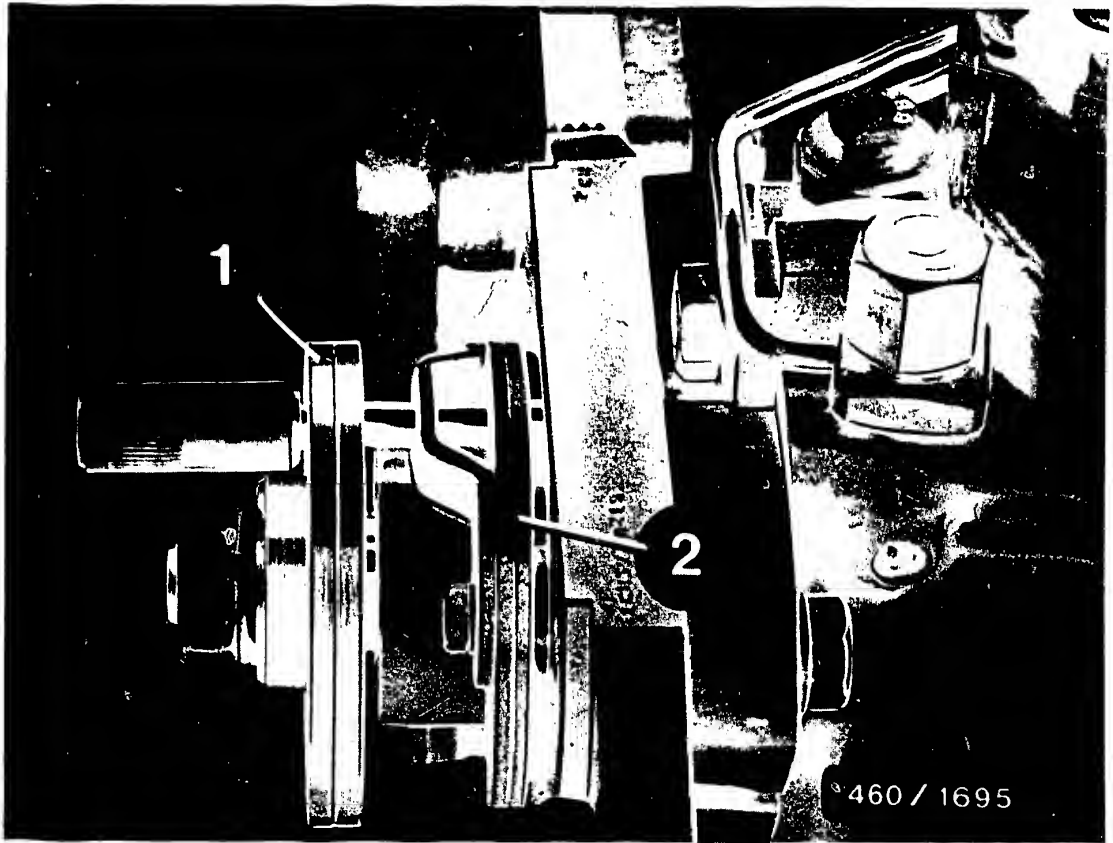
Mount piston-lift measuring tool and set dial indicator to "zero" at BDC position of distributor-type fuel-injection-pump plunger.

**E6**

Install fuel-injection pump

Ford

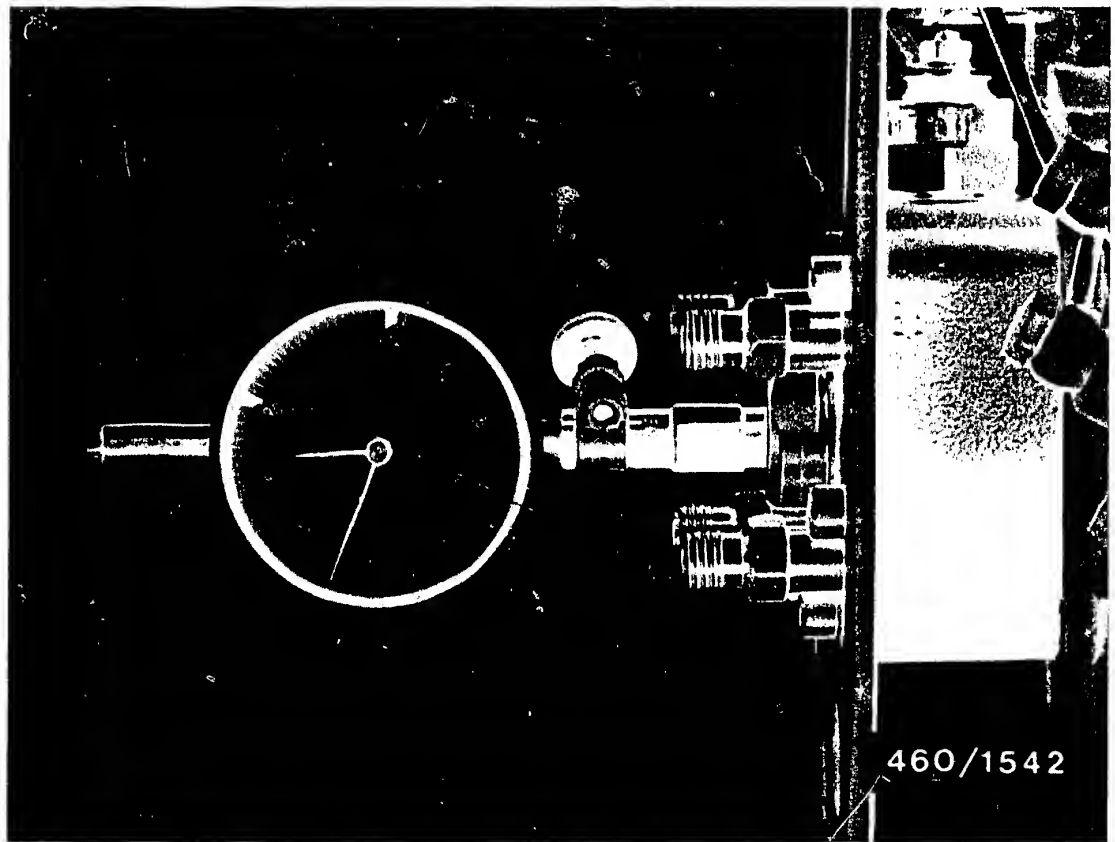




- 1 = Coupling half  
2 = Notched plate

Turn pump drive shaft in the direction of pump rotation until locating pin KDEP 1150 can be pushed through the coupling half and notched plate.





1 = Plunger-lift measuring tool

Unload drive shaft with locating pin positioned and compare plunger lift indicated with the value required in accordance with the test-specifications sheet.

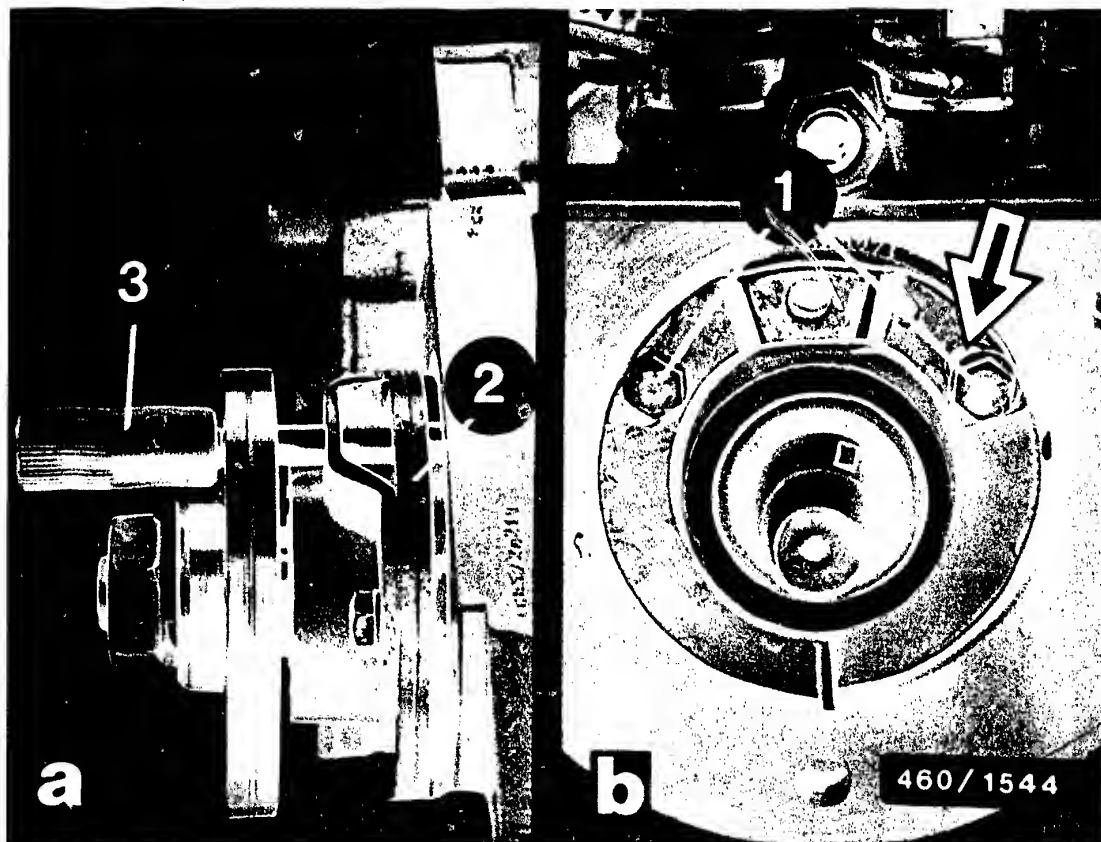
If plunger lift is not obtained, adjust plunger lift.

**E8**

Install fuel-injection pump

Ford





1 = Fastening screws  
2 = Notched plate

3 = Locating pin

### 28.1 Adjust plunger lift

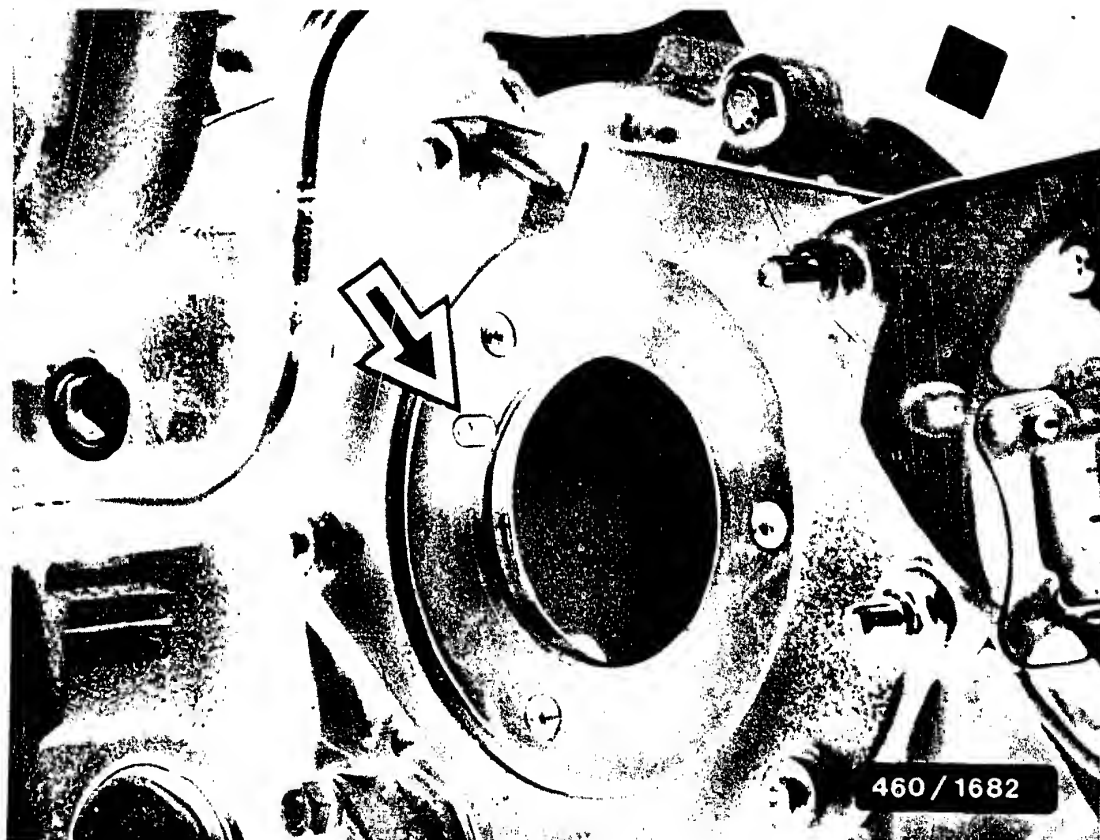
Loosen fastening screws of notched plate and tighten in new position in such a way that the plunger lift as stated in the test-specification sheet is obtained when the drive shaft is relieved of load.

Remove locating pin.

Mount original timing-device cover.

Remove plunger-lift measuring tool and mount bleeder screw with new seal. Tighten fastening screws of notched plate to 4 - 6 Nm.





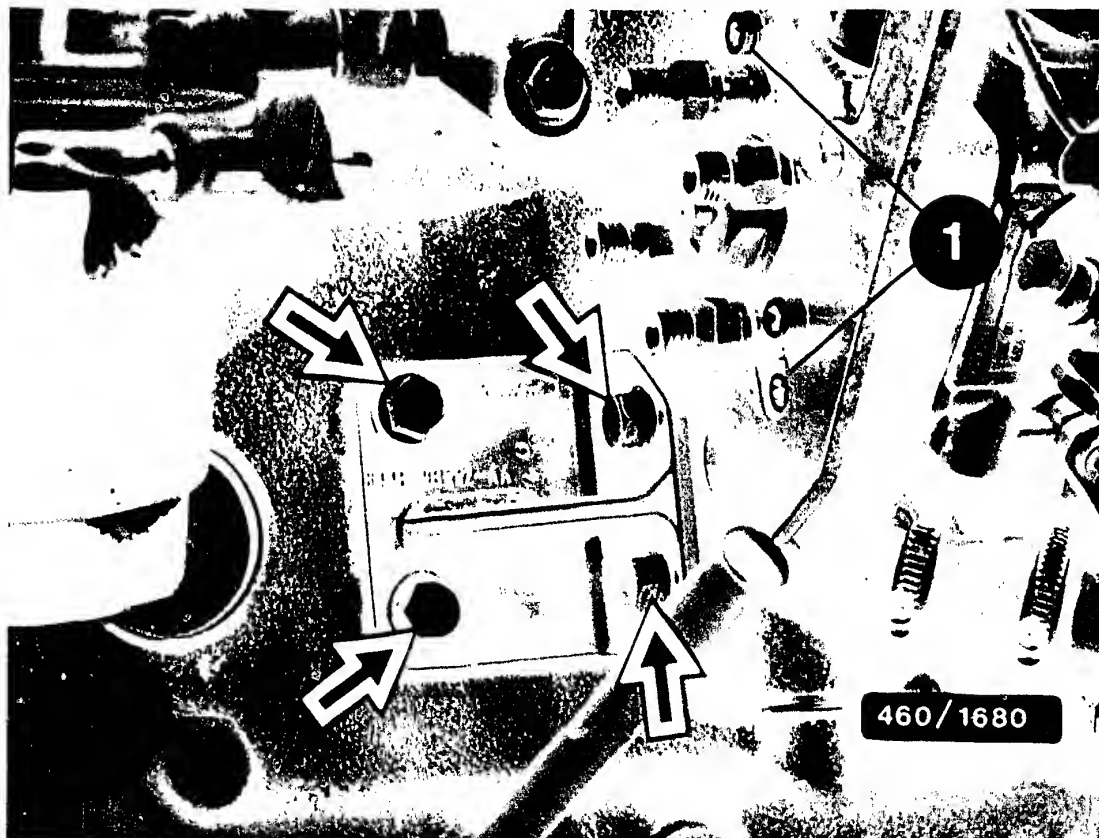
Insert injection pump carefully into locating sleeve (arrow) at the rear side of the intermediate flange and secure injection pump.

**E10**

Install fuel-injection pump

Ford





1 = Bracket

Mount bracket on injection pump and cylinder block.

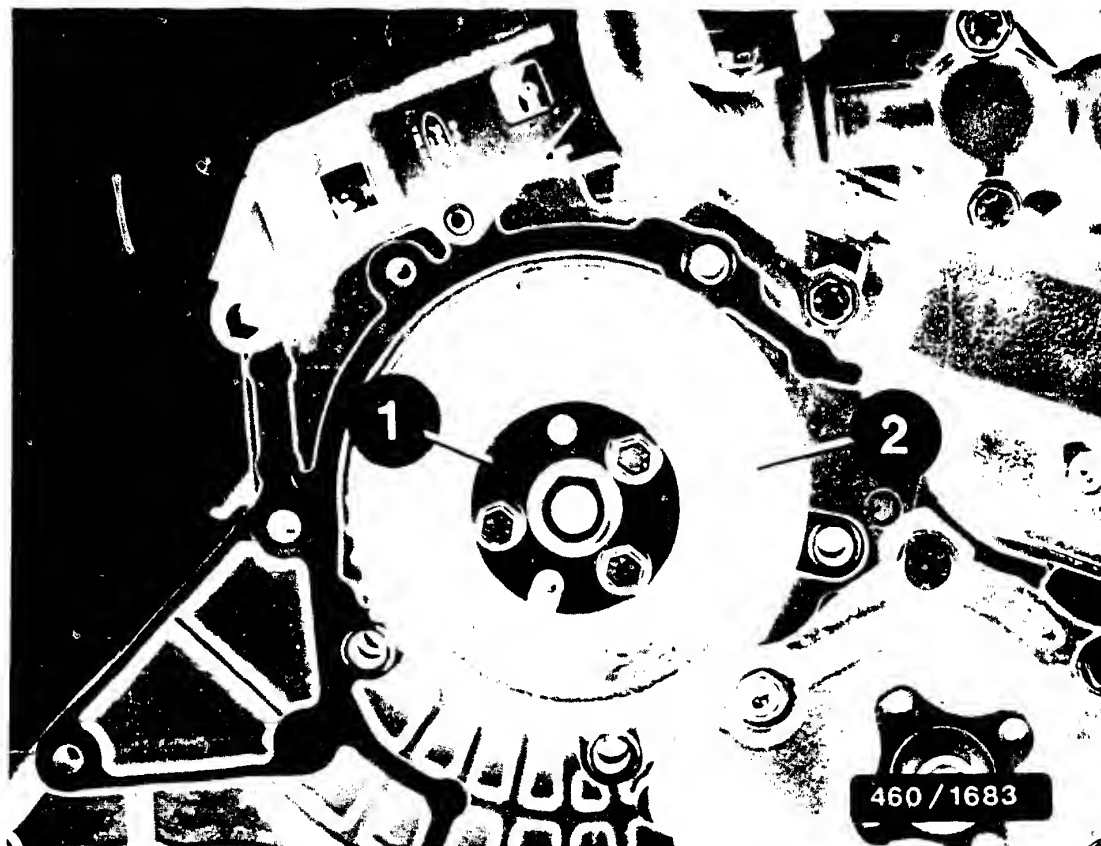
Note:

Tighten fastening screws evenly. Make sure that the holder does not make the injection pump fit askew.

Tighten fastening screws of bracket to 21 - 26 Nm.







1 = Hub  
2 = Disc

Push injection-pump driving gear onto hub of injection pump.

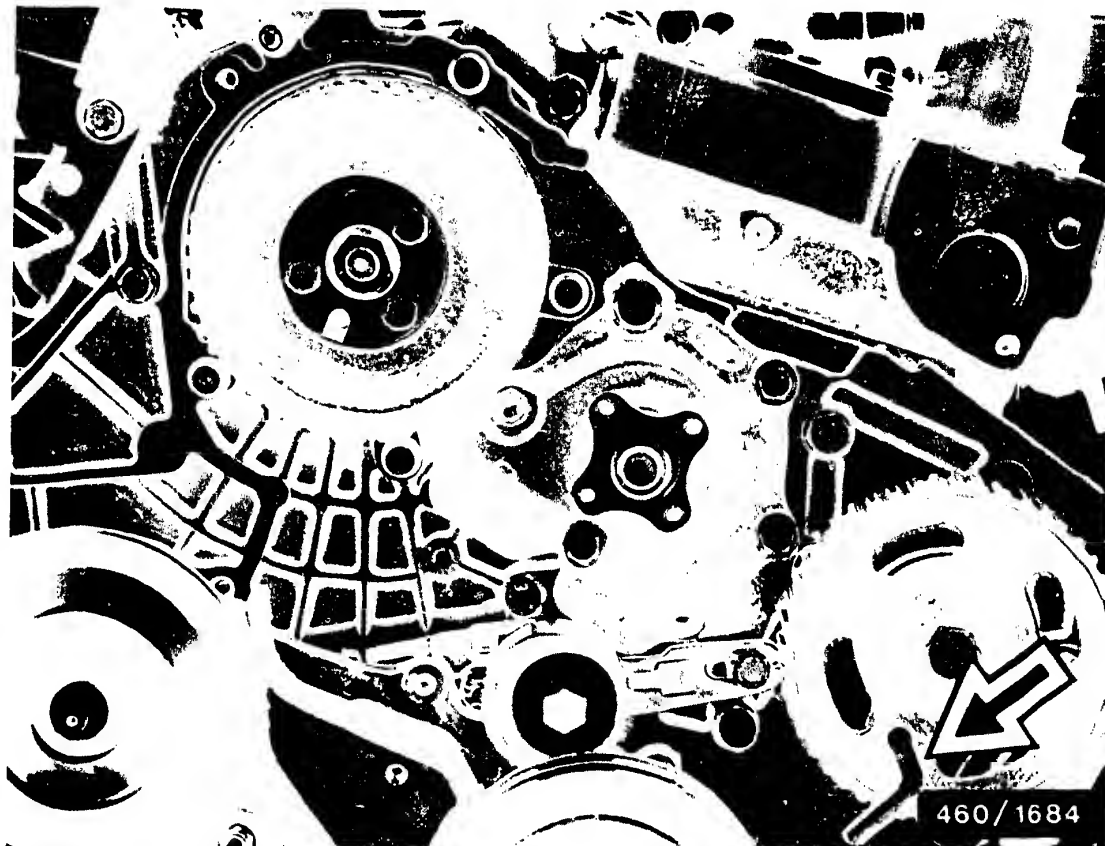
Mount disk and fastening screws.  
Tighten fastening screws lightly.

**E12**

Install fuel-injection pump

Ford



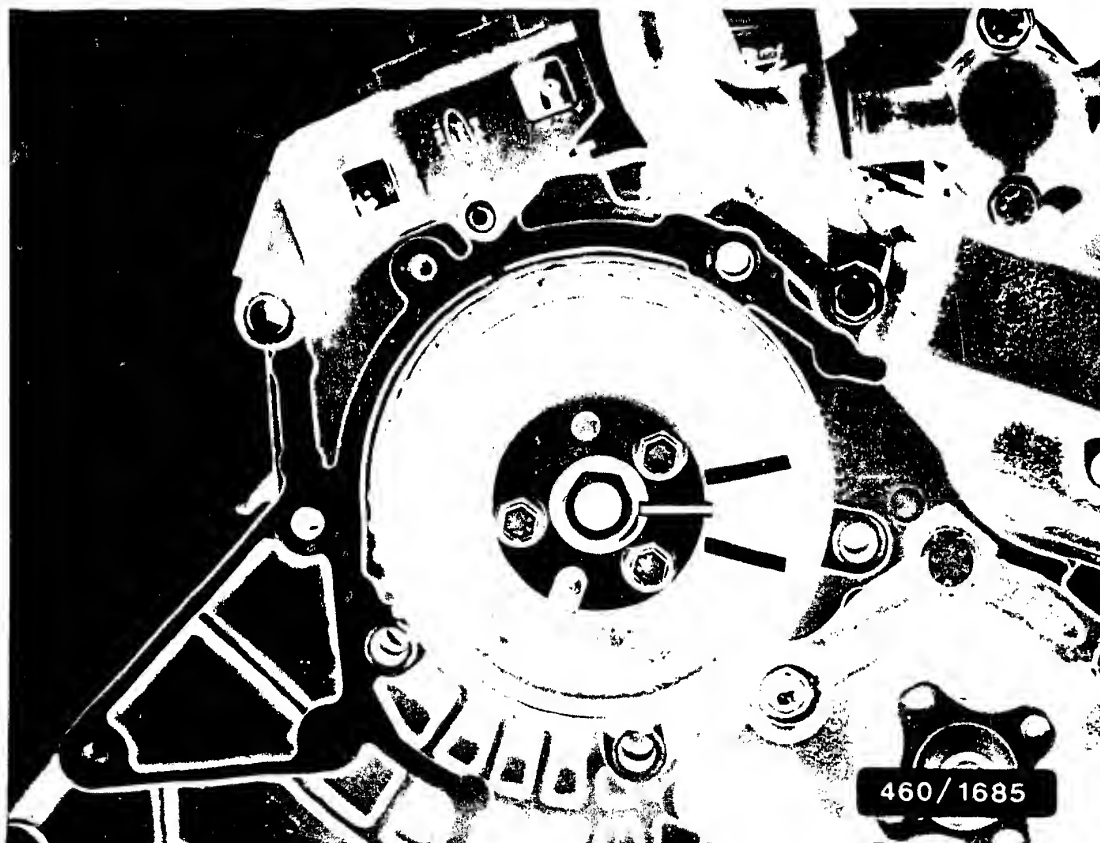


Locate camshaft drive gear with locating pin KDEP 1161/2 (arrow).

**E13**

Install fuel-injection pump  
Ford





Turn pump drive gear to the left as far as it will go.

Mark position of drive gear.

Turn pump drive gear to the right as far as it will go and likewise mark position.

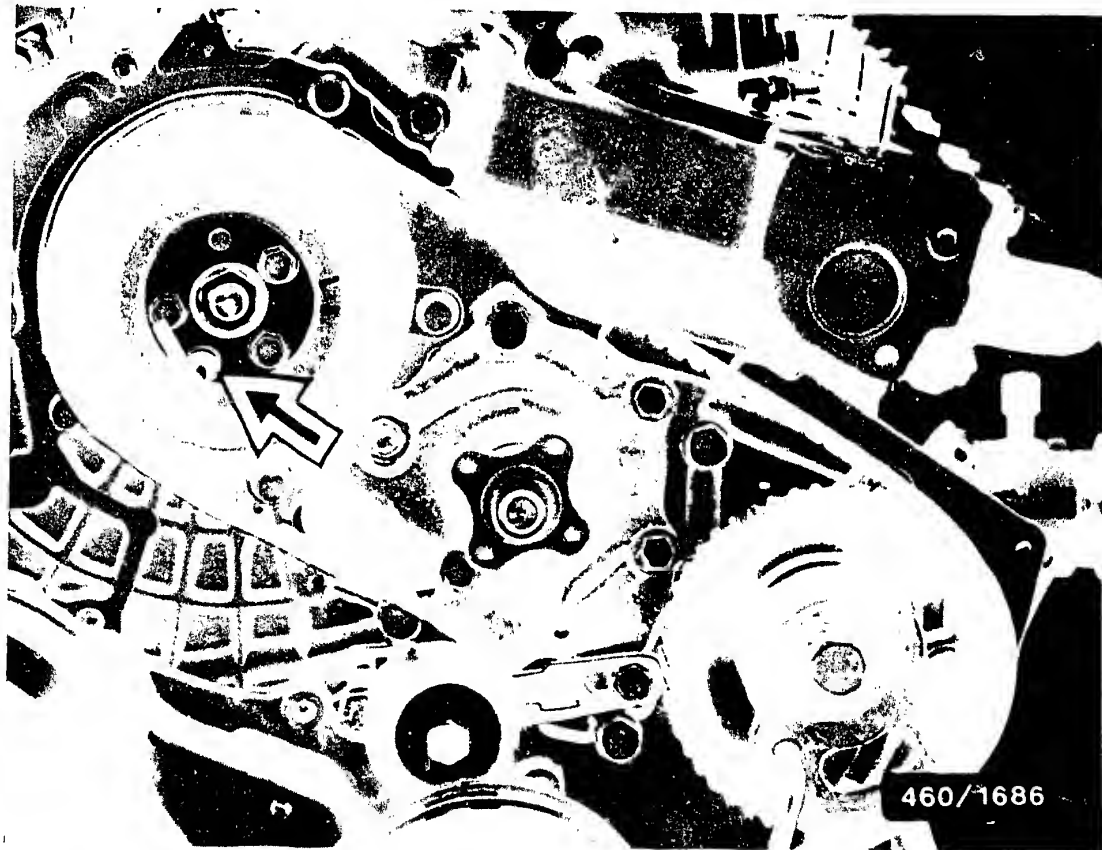
Position drive gear at the center point between the two markings.

**E14**

Install fuel-injection pump

Ford





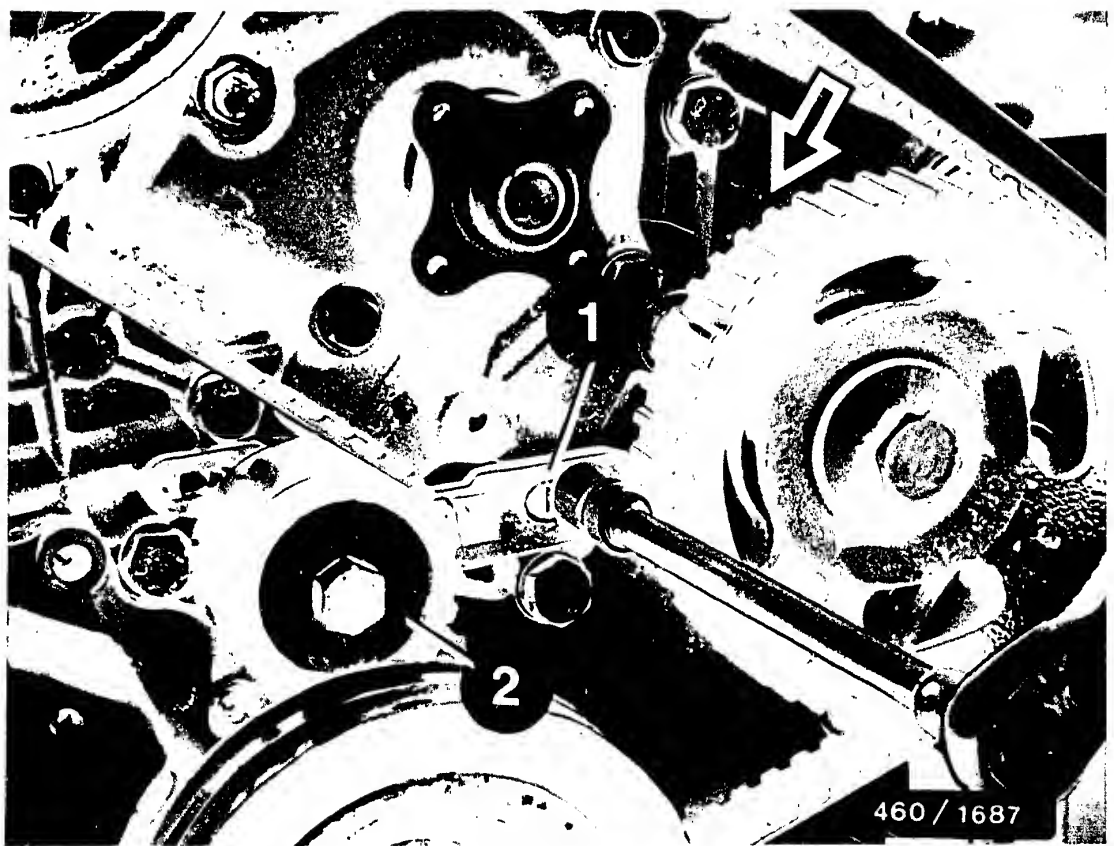
Locate injection-pump gear with locating pin KDEP 1161/1 (arrow).

Starting from the crankshaft gear, position toothed belt into the tothing of the camshaft gear and then under tension over the injection-pump gear.

Note:

It may be necessary to turn the injection-pump gear.





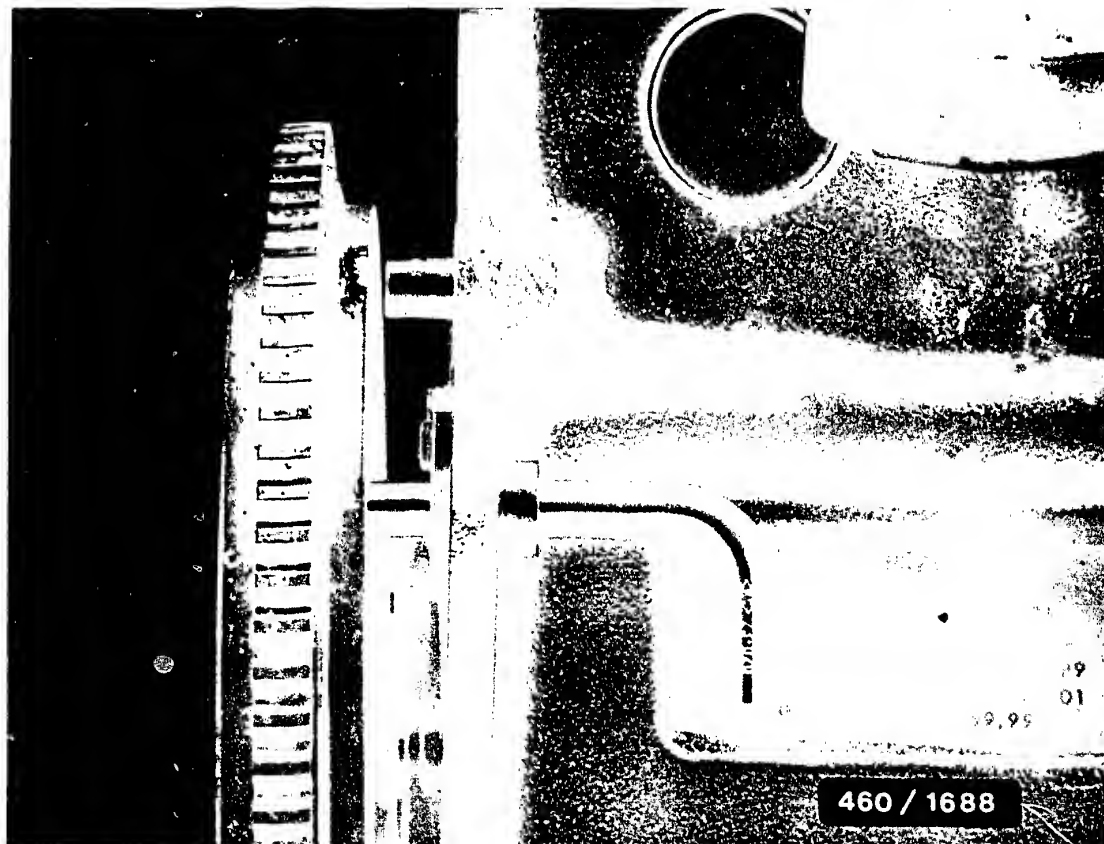
- 1 = Belt-adjustment link
- 2 = Belt tensioning roller

Loosen belt-adjustment link.  
Push down on toothed belt along longest stretch of  
belt and release (arrow).

Tighten belt tensioning roller and fastening screw of  
belt-adjustment link to 20 - 25 Nm.

Remove locating pins for flywheel, camshaft gear and  
injection-pump gear.





Turn crankshaft in direction of engine rotation (two rotations) and insert locating pin KDEP 1161/3 into flywheel.

Note:

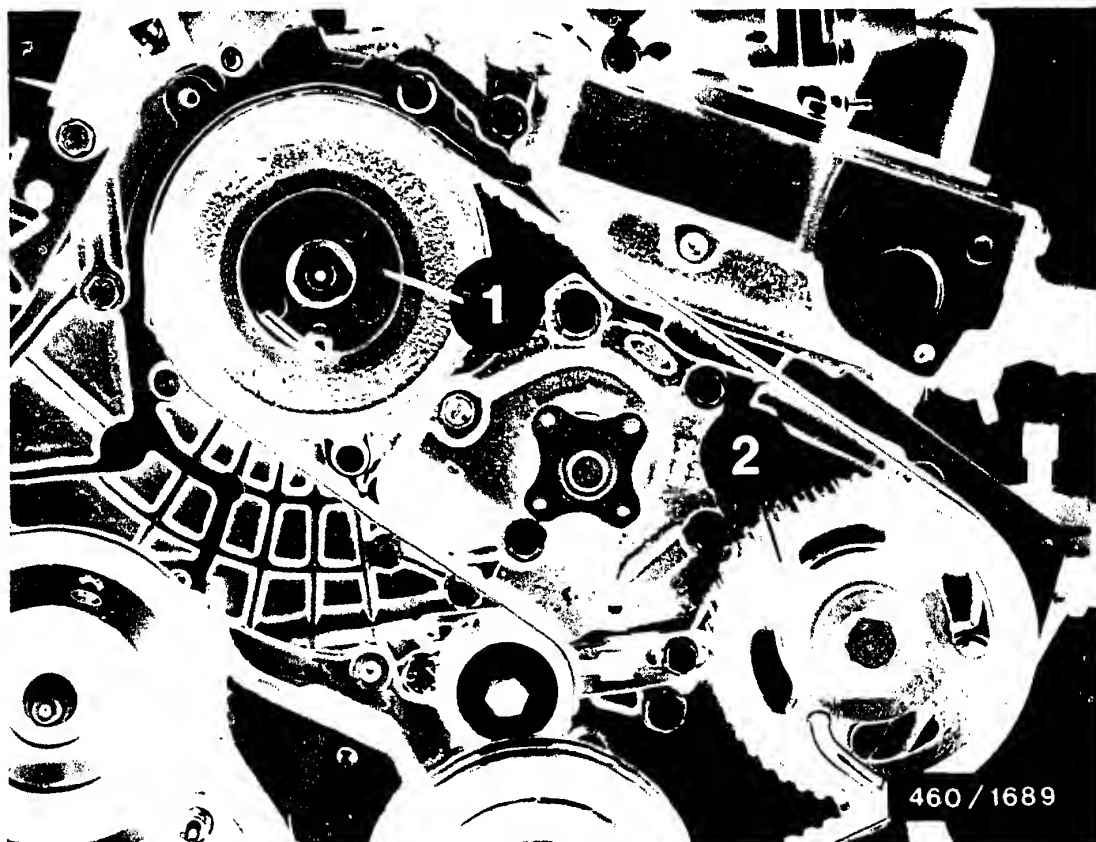
Crankshaft position 11° before TDC.

**E17**

Install fuel-injection pump

Ford





- 1 = Injection-pump gear  
2 = Camshaft gear

Locate camshaft gear and injection-pump gear in this engine position using locating pins.

If injection-pump gear cannot be located, adjust injection-pump-gear locking mechanism as described in Coordinates E19 - E21.

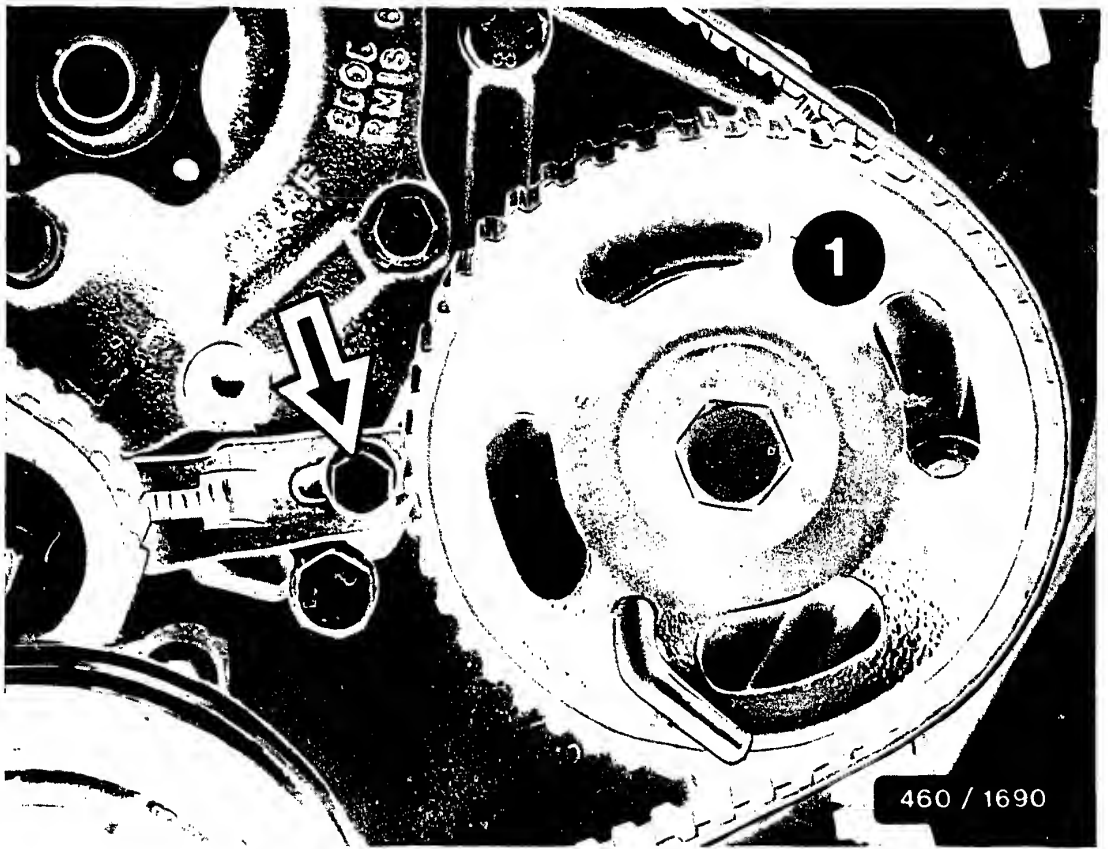
If adjustment of the injection-pump gear is not necessary, continue with Coordinate E22.

**E18**

Install fuel-injection pump

Ford





Lock camshaft drive gear with KDEP 1161/2.

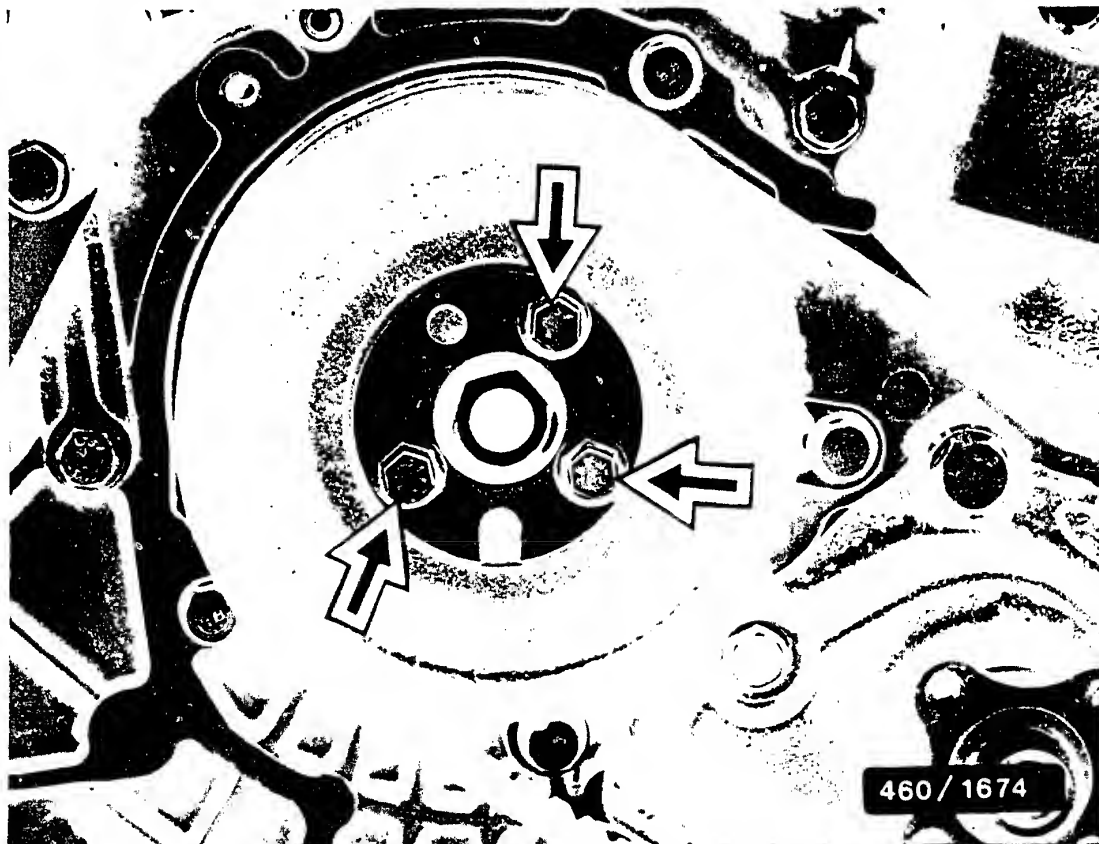
**E19**

Install fuel-injection pump

Ford







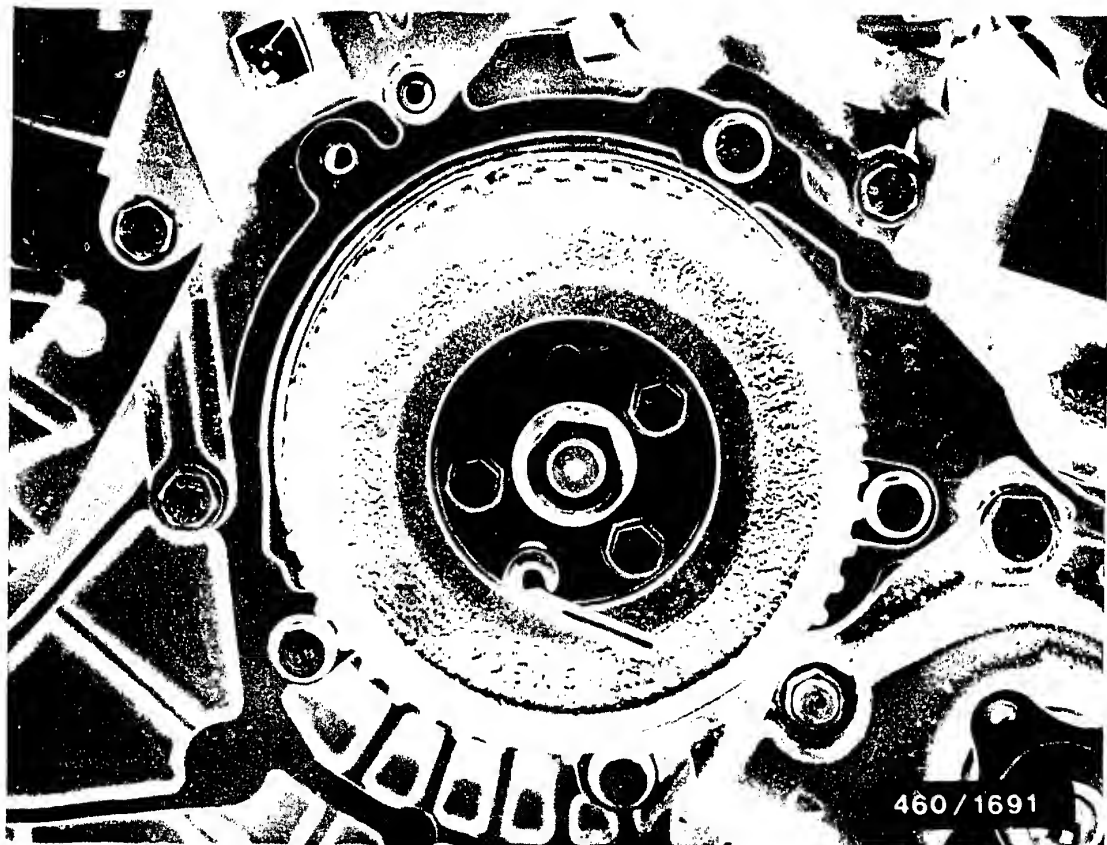
Loosen fastening screws of injection-pump drive gear (arrows).

**E20**

Install fuel-injection pump

Ford

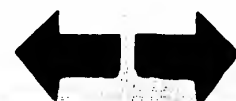


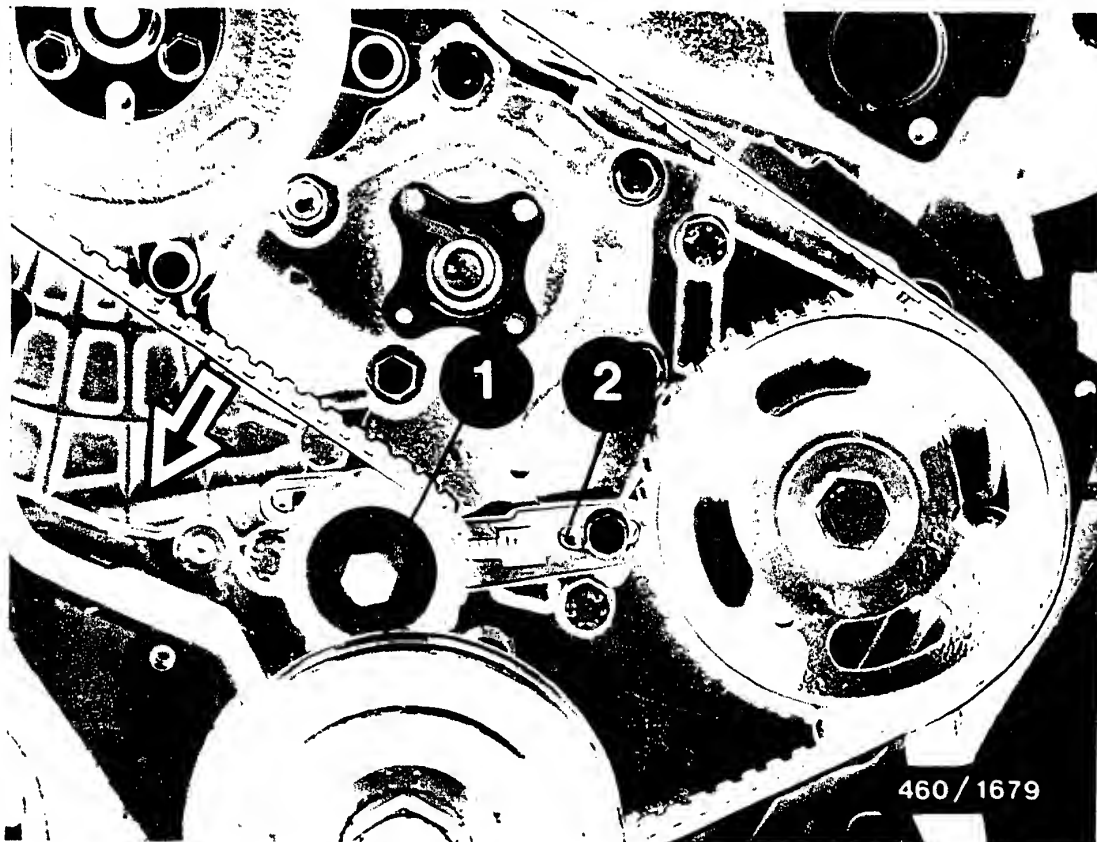


Turn injection-pump drive gear until locating pin KDEP 1161/1 may be inserted. Tighten fastening screws to 22 - 27 Nm.

Note:

If drive gear cannot be adjusted by turning, remove toothed belt and adjust injection pump in such a way that the fastening screws are positioned at the center of the slots in the driving gear. Position toothed belt and tighten.





- 1 = Belt tensioning roller
- 2 = Belt-adjustment link

Remove locating pins for flywheel, camshaft gear and injection-pump gear.

Turn crankshaft in direction of engine rotation. Loosen fastening screws of belt tensioning roller and belt-adjustment link. Push down on toothed belt along longest stretch of belt and release. Tighten fastening screws of belt tensioning roller and belt-adjustment link to 20 - 25 Nm.



Assemble fuel supply line, fuel return line, electric lead at shutoff solenoid and hydraulic cold-start injection advance and fuel-injection tubing on injection pump.

**E23**

Install fuel-injection pump

Ford



Mount rocker-arm shaft with new seal and tighten fastening screws.

Adjust valve clearance in accordance with engine manufacturer's specifications. Mount cylinder-head cover with new seal and tighten to 6 - 8 Nm.

Secure cylindrical-gear cover.

Mount viscous fan onto water-pump shaft.

Pull V belt over fan/generator and tighten with fastening screws.

Pull on V belt for vacuum pump and tighten with V-belt clamping fixture.

Install radiator.

Mount radiator grid.

Bleed fuel system.

Adjust accelerator-pedal actuation cable (bowden cable).



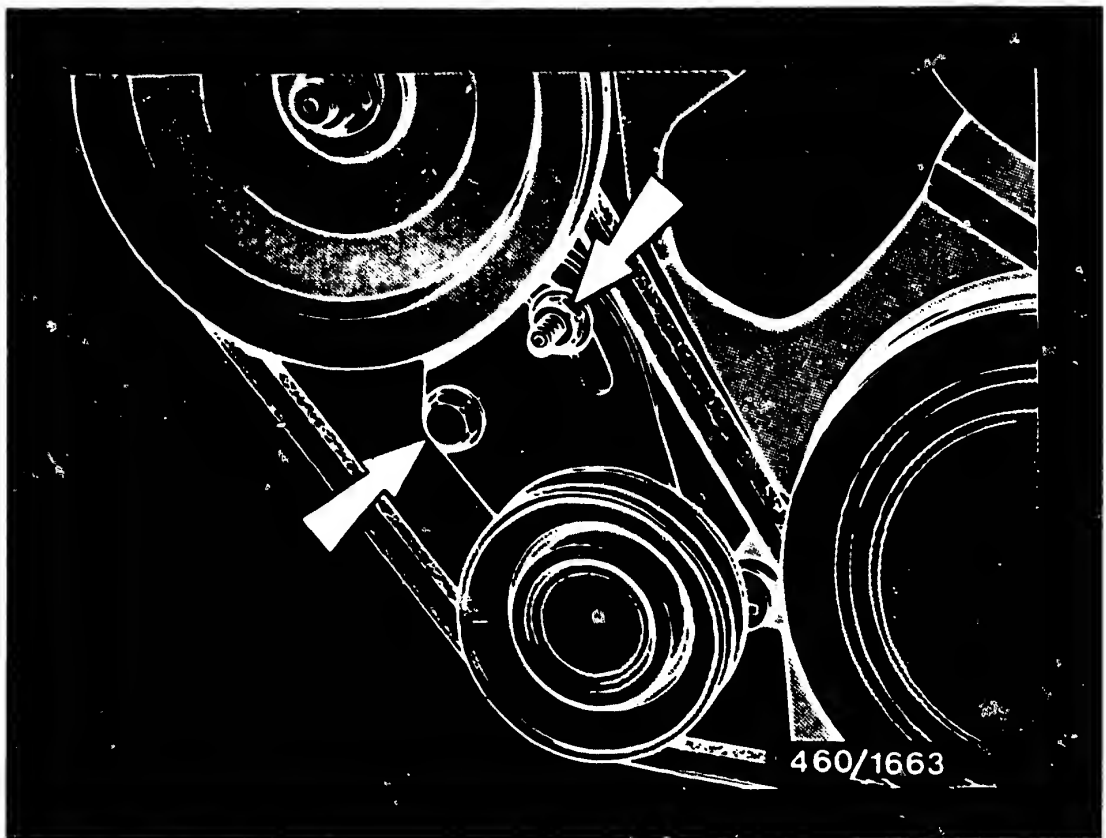
## 29. Test and adjust engine timing

### 29.1 Test engine timing

Disconnect negative cable from battery.

Remove plastic plug from the adjustment opening (flywheel) at the rear in the cylinder head near the engine nameplate.

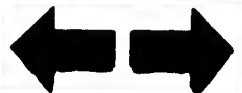


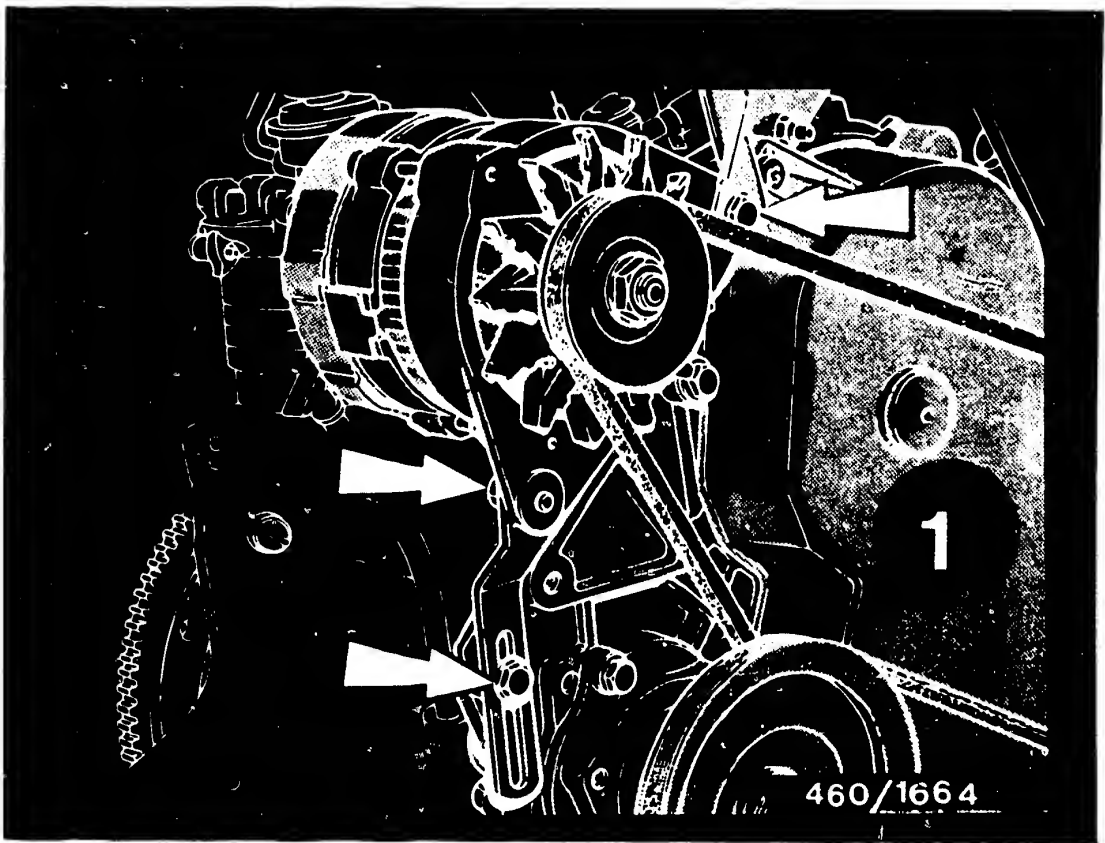


Remove radiator grid.  
Drain coolant and remove radiator.

Loosen nut on viscous fan and pull fan off the  
water-pump shaft.

Unscrew water-pump pulley from water-pump flange (four  
bolts) and pull off.  
Loosen clamping device of V-belt (arrows) and remove  
belt.





1 = Cylindrical-gear cover

Loosen fastening screws used for adjusting the alternator (arrows) and lift off V-belt. Unscrew cylindrical-gear cover (1).







Turn crankshaft in direction of engine rotation until the valves of cylinder 4 are slightly before overlap.

Insert locating pin KDEP 1161/3 into flywheel and apply pressure.

Turn crankshaft further until locating pin engages into hole (flywheel).

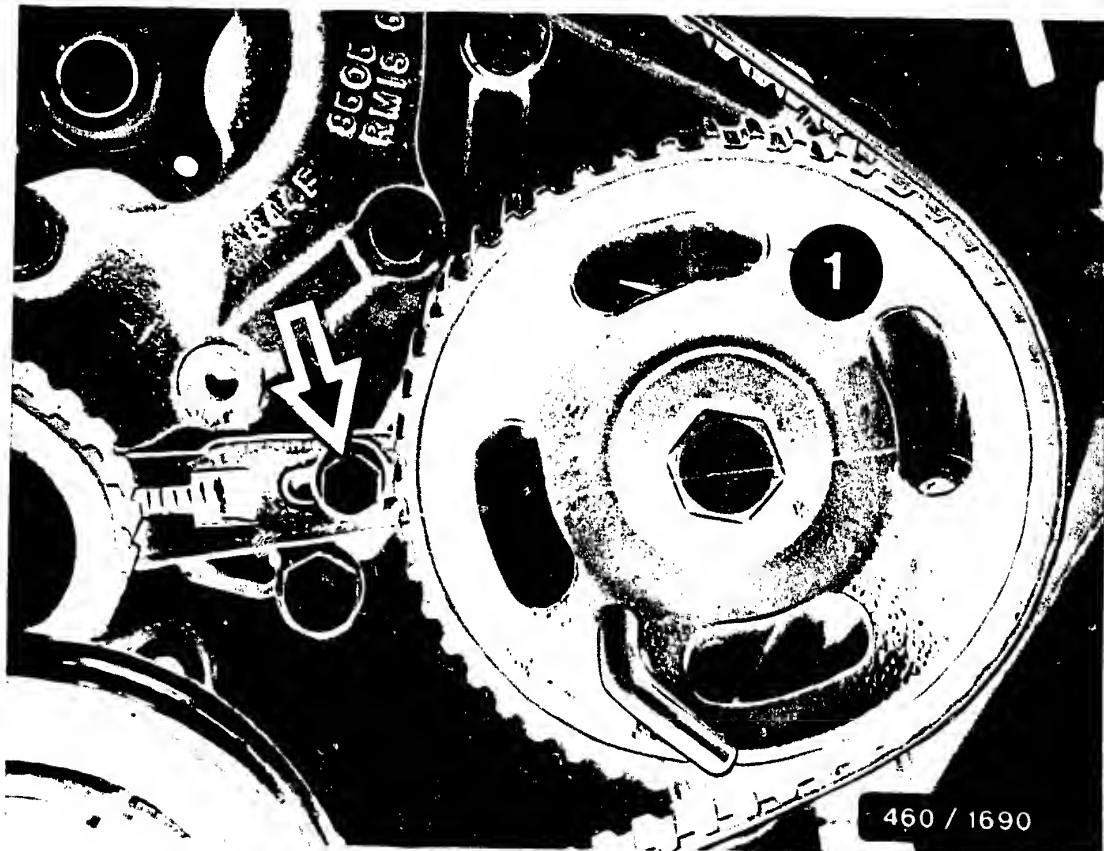
In this position, the crankshaft is at  $11^{\circ}$  before TDC for cylinder 1.

**F4**

Test and adjust engine timing

Ford



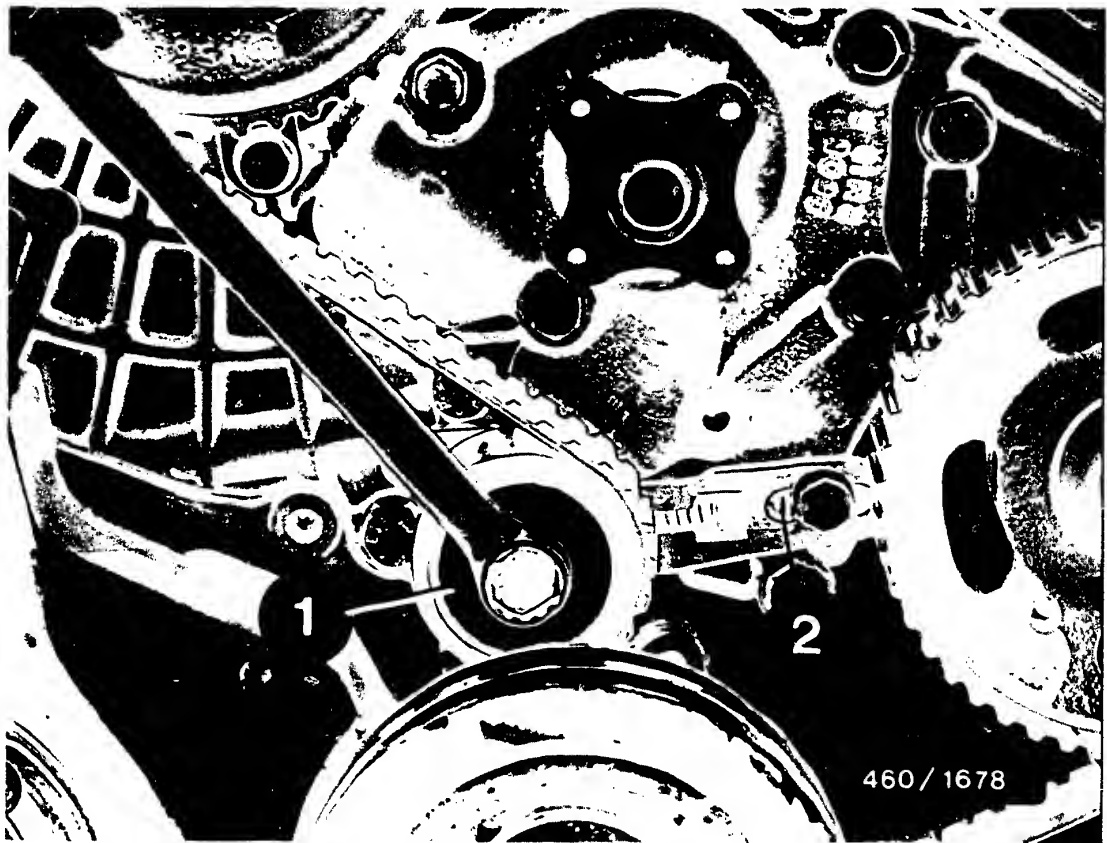


1 = Camshaft driving gear

Lock camshaft with locating pin KDEP 1161/2.

If locating pin cannot be inserted, adjust engine timing.





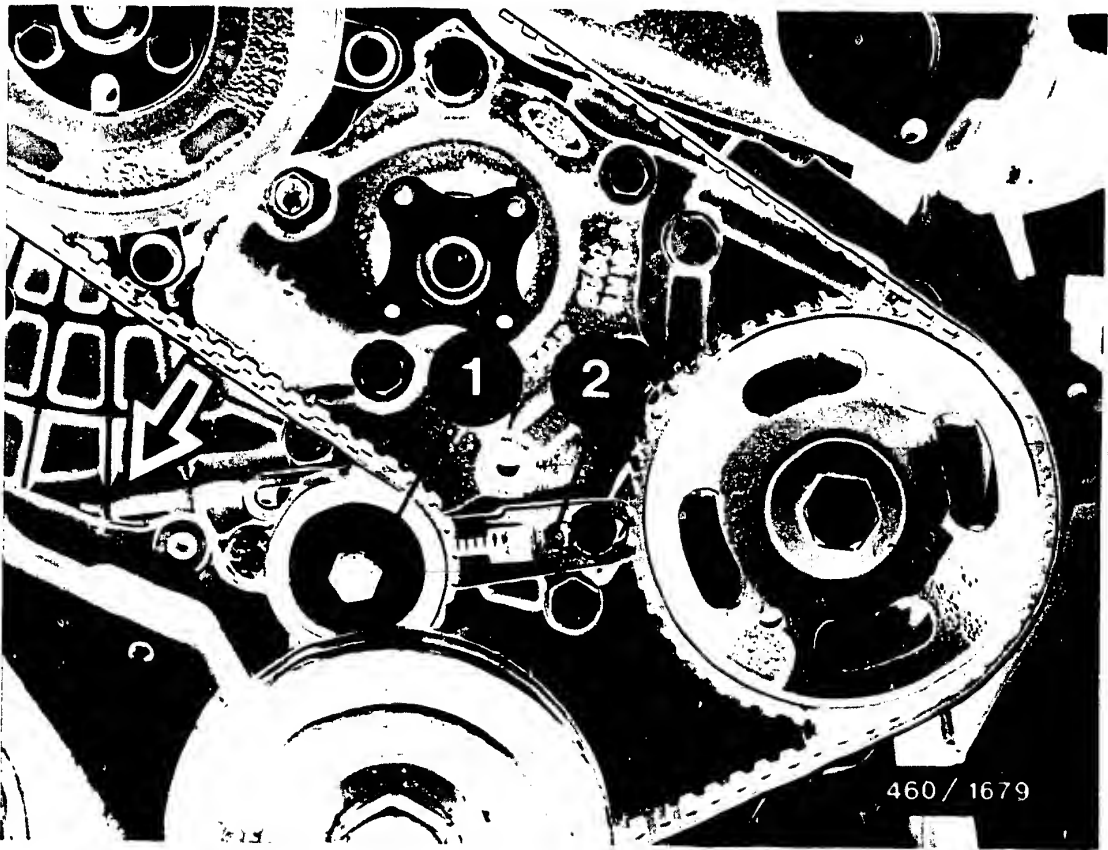
- 1 = Belt tensioning roller  
2 = Belt-adjustment link

### 29.2 Adjust engine timing

Locate injection-pump gear with locating pin KDEP 1161/1.

Loosen fastening screw of belt tensioning roller and fastening screw of belt-adjustment link on end cover.



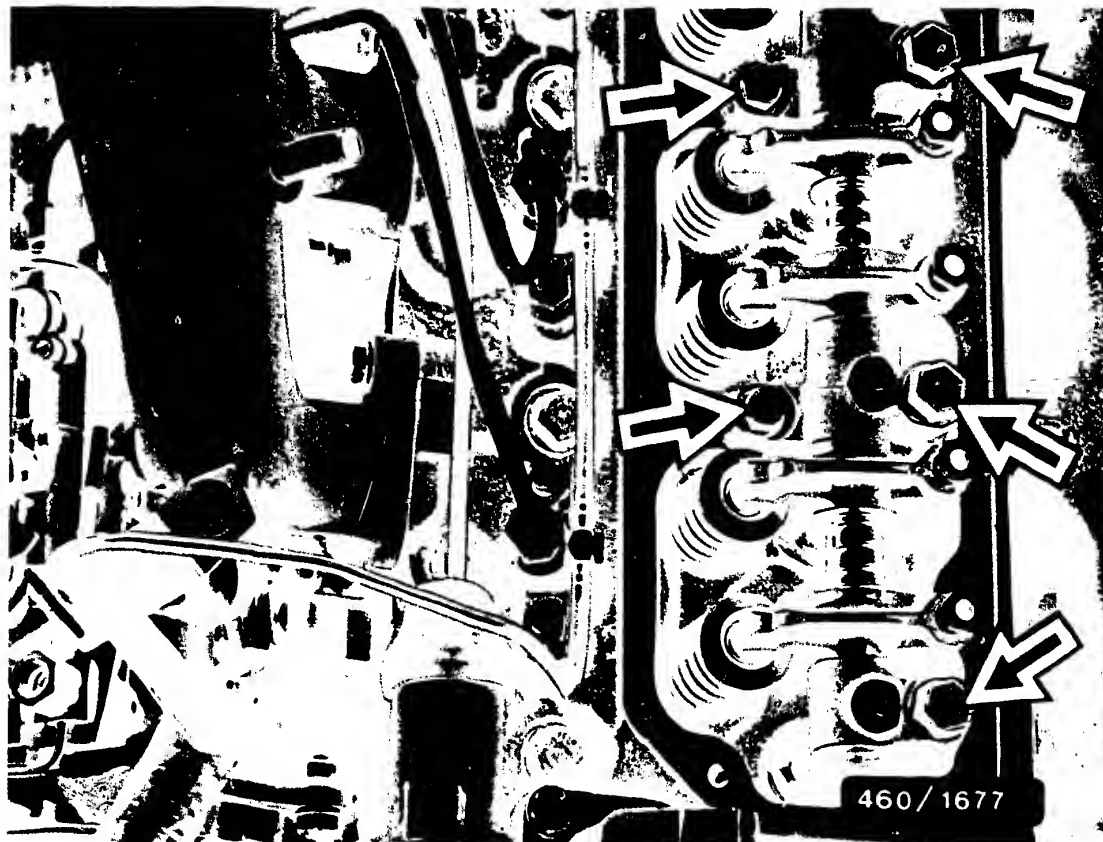


- 1 = Belt tensioning roller
- 2 = Belt-adjustment link

Push belt tensioning roller in direction of arrow and tighten belt tensioning roller and belt-adjustment link in this position.

Remove toothed belt.





Turn camshaft driving gear until locating pin can be inserted.

Note:

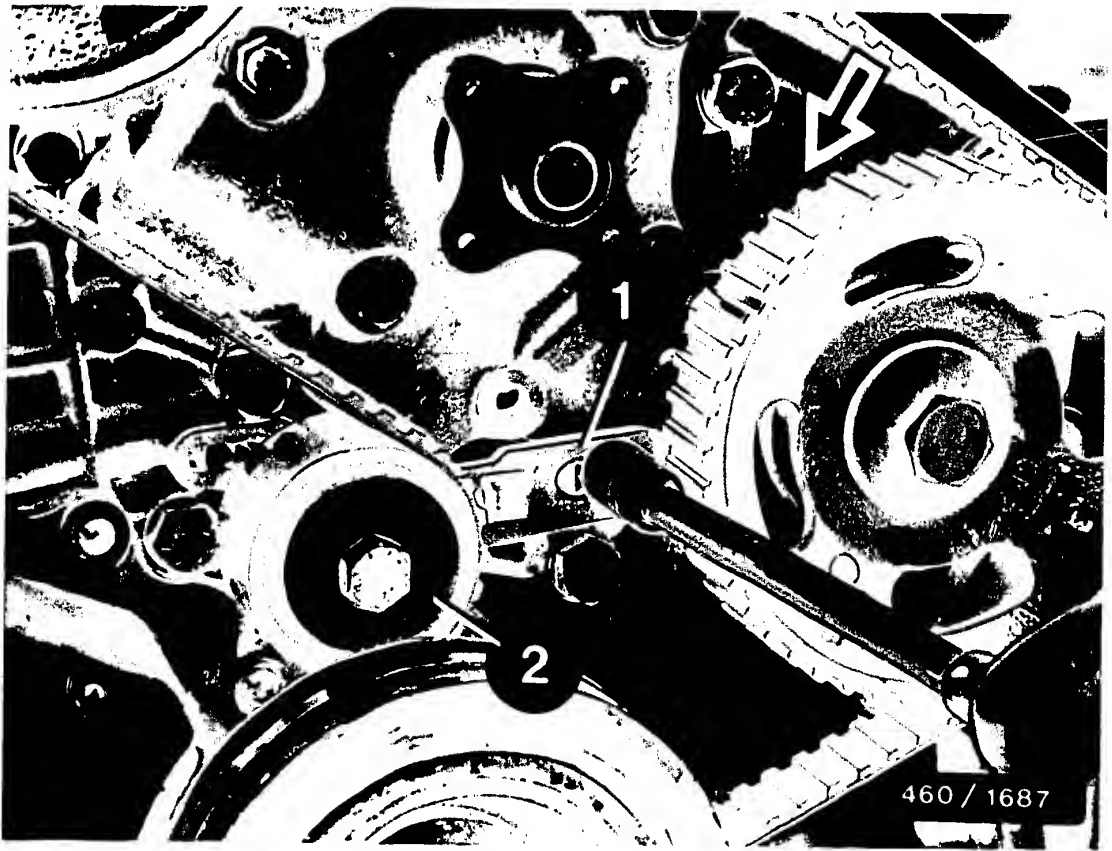
Do not remove locating pins KDEP 1161/2 and KDEP 1161/1.

Disassemble rocker-arm shaft.

Note:

Disassembling the rocker-arm shaft prevents the torque generated by the valve springs from being transmitted to the toothed belt via the camshaft gear and thus prevents impermissible alteration of the belt tension and the start of delivery.





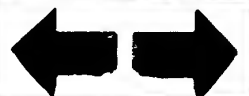
- 1 = Belt-adjustment link  
2 = Belt tensioning roller

Starting at the crankshaft gear, position the toothed belt into the tothing of the camshaft gear and then under tension position the belt over the injection-pump gear.

Push down on toothed gear along the longest stretch of belt and release (arrow).

Tighten belt tensioning roller and fastening screw of belt-adjustment link to 21 - 26 Nm.

Remove locating pins for flywheel, camshaft gear and injection-pump gear.



Assemble rocker-arm shaft with new seal and tighten fastening screws.

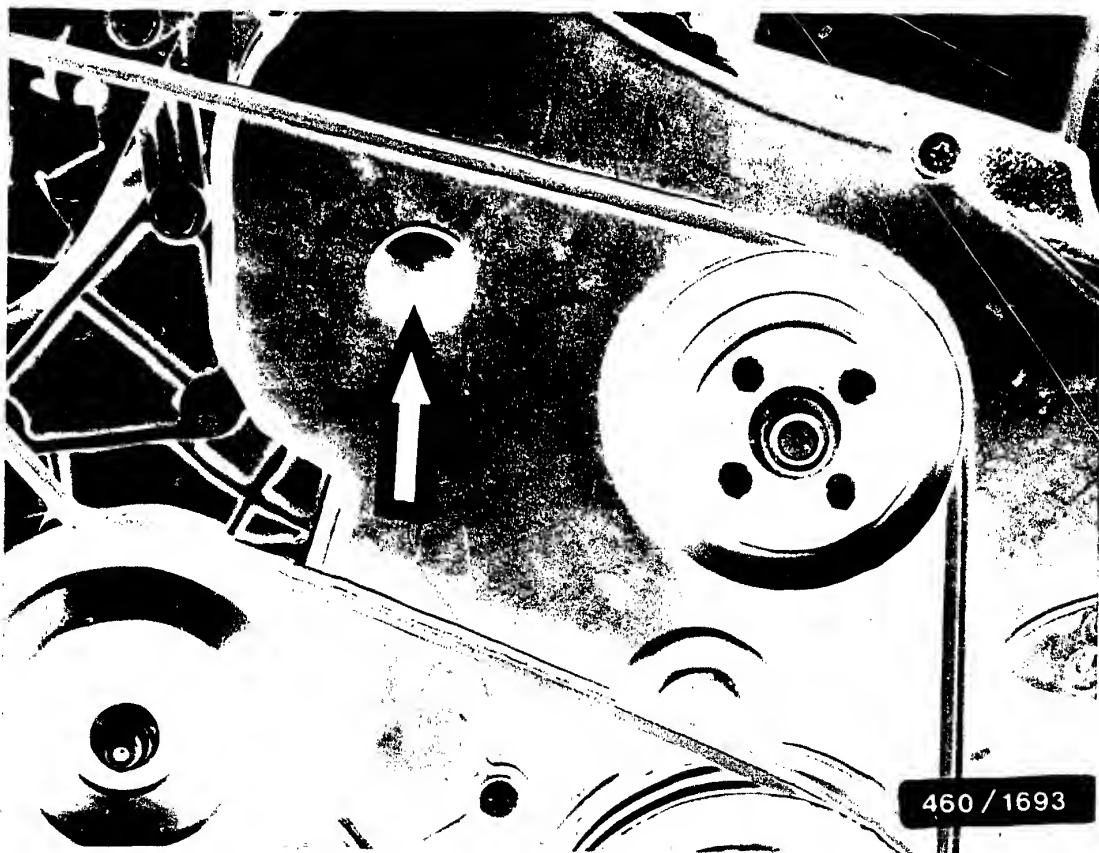
Adjust valve clearance in accordance with engine manufacture's specifications. Mount cylinder-head cover with new gasket and tighten to 6 - 8 Nm.

**F10**

Test and adjust engine timing

Ford





30. Coordination, injection-pump - engine (injection timing)

Disconnect negative cable from battery.

Remove plastic plug from the adjustment opening (flywheel) at the rear in cylinder head near to engine nameplate.

Remove rubber plug from the cylindrical-gear cover (arrow).







Turn crankshaft in direction of engine rotation until the valves of cylinder 4 are slightly before overlap.

Insert locating pin KDEP 1161/2 into flywheel and apply pressure.

Turn crankshaft further until locating pin engages into hole (flywheel).

In this position, the crankshaft is at  $11^{\circ}$  before TDC for cylinder 1.

**F12**

Coord., inj.-pump - engine (inj. timing)

Ford





Insert locating pin KDEP 1161/1 through the opening in the cylindrical-gear cover into the locating bore of injection pump and drive flange and locate injection-pump driving gear.

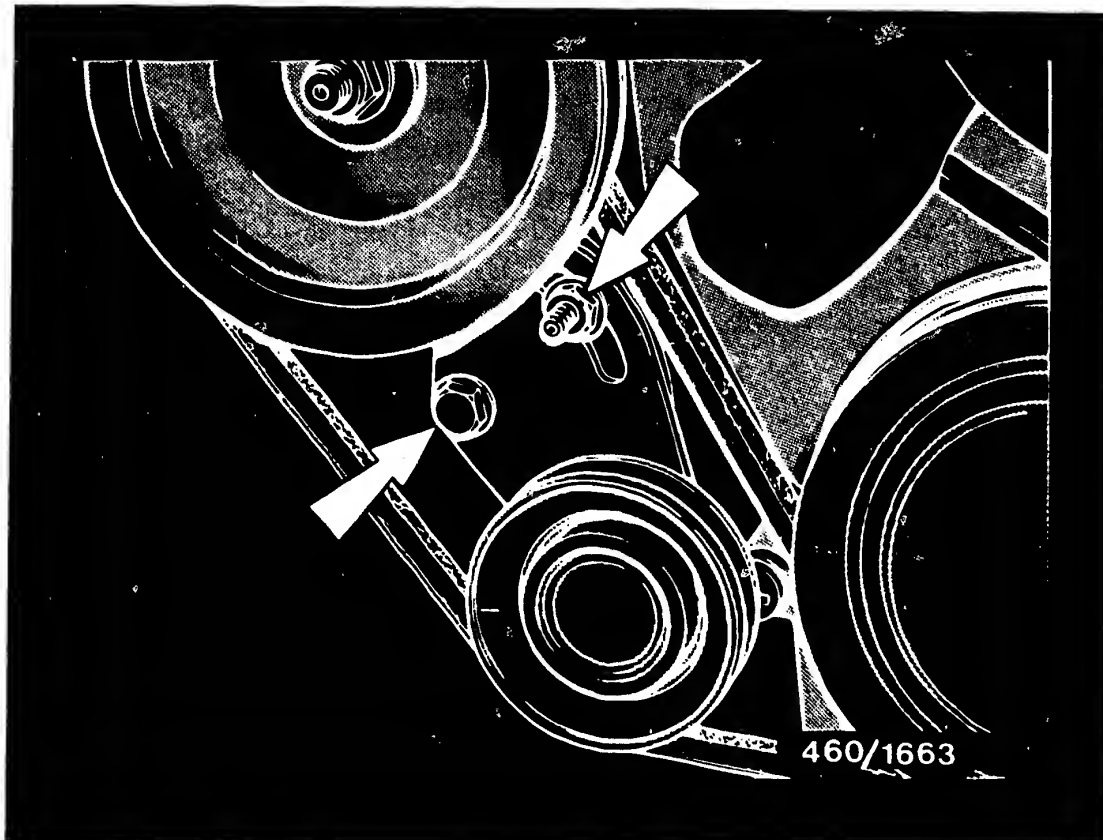
If locating pin KDEP 1161/1 cannot be inserted, adjust coordination of injection pump to engine (injection timing).

Remove locating pin.

**F13**

Coord., inj.-pump - engine (inj. timing)  
Ford





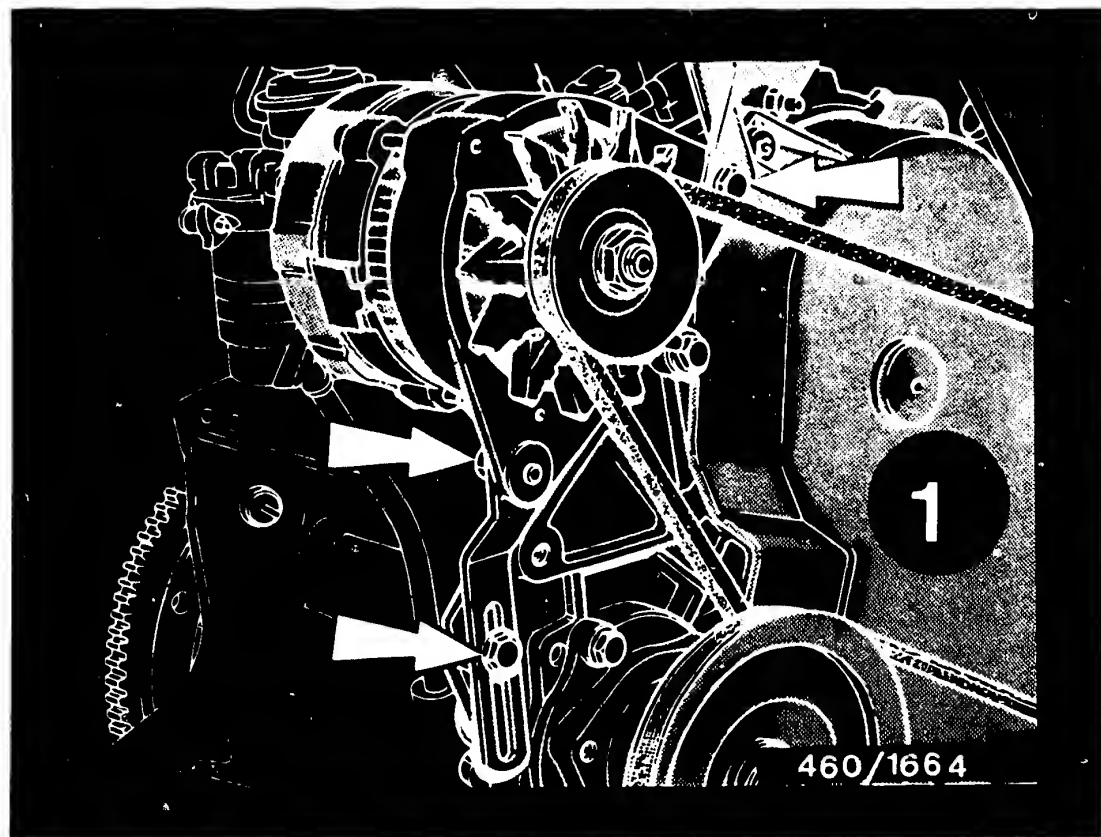
Remove radiator grid.  
Drain coolant and remove radiator.

Loosen nut on viscous fan and pull fan off the  
water-pump shaft.

Unscrew water-pump pulley from water-pump flange (four  
bolts) and pull off.

Loosen clamping device of V-belt (arrows) and remove  
belt.





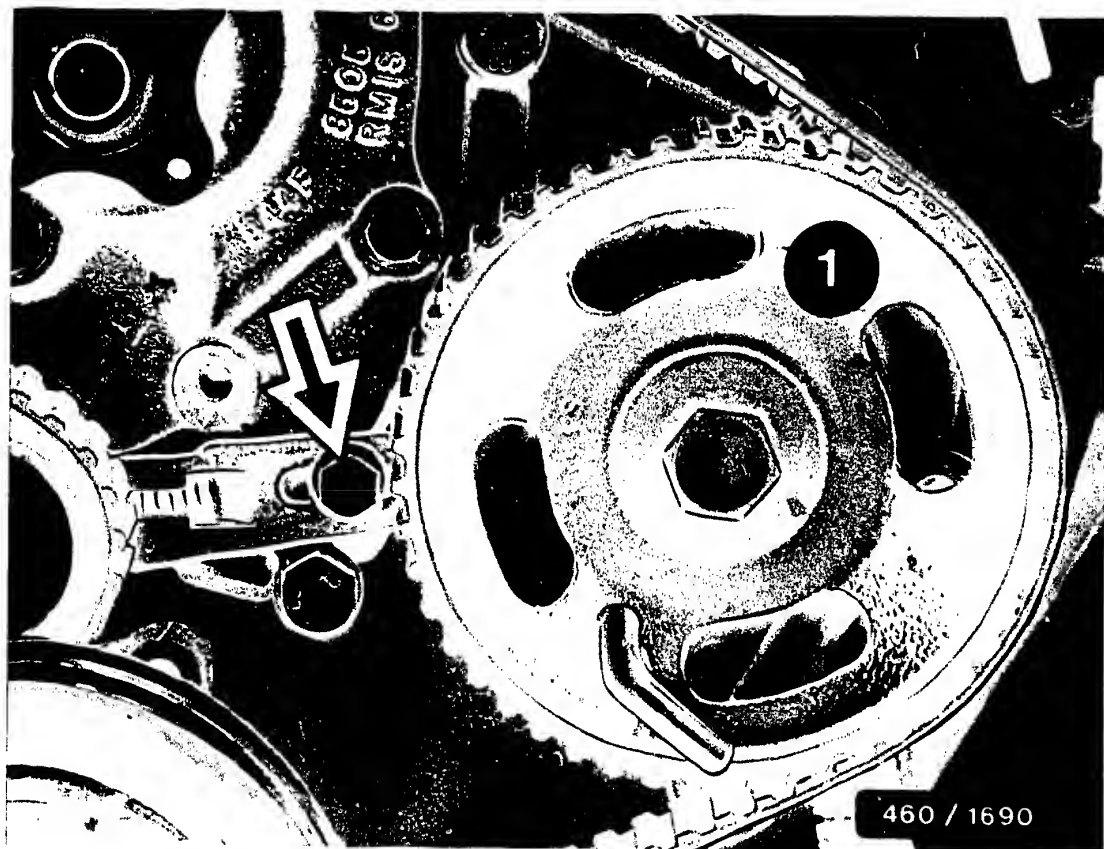
1 = Cylindrical-gear cover

Loosen fastening screws used for adjusting the alternator (arrows) and lift off V-belt.  
Unscrew cylindrical-gear cover (1).

**F15**

Coord., inj.-pump - engine (inj. timing)  
Ford



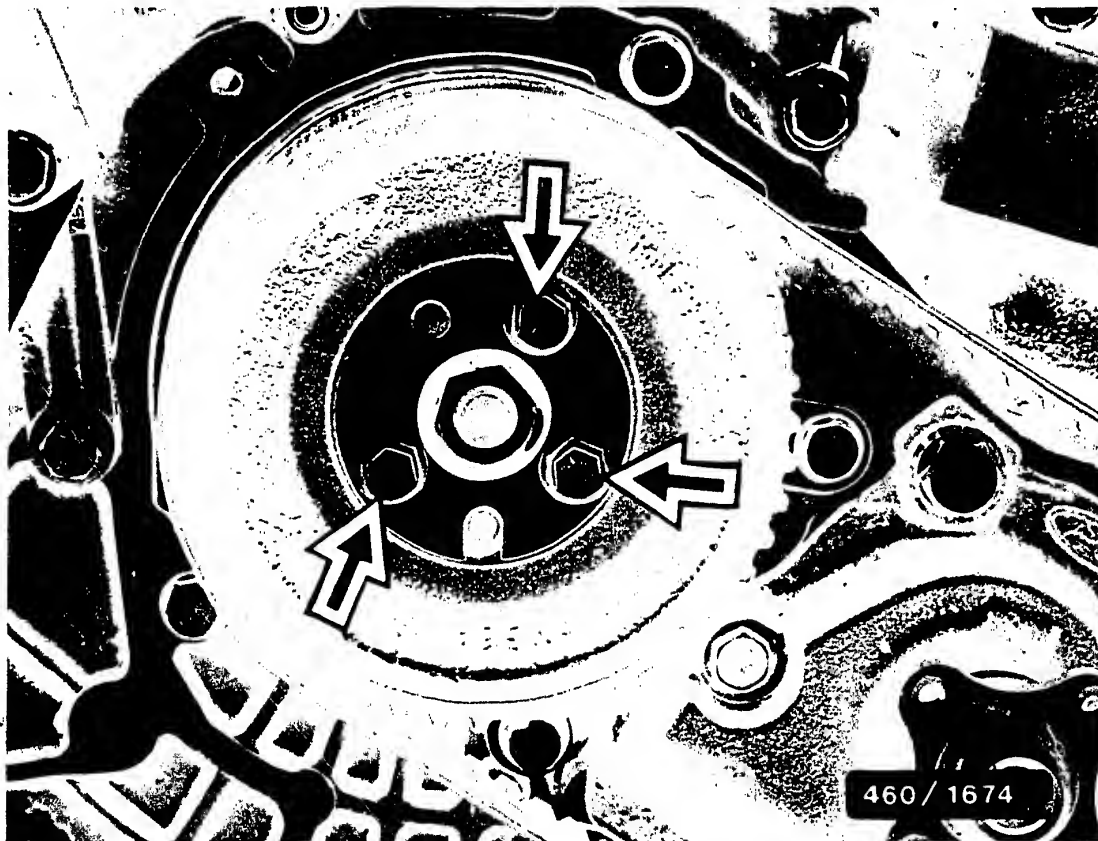


Insert locating pin KDEP 1161/3 into flywheel.

Lock camshaft driving gear with KDEP 1161/2.

Attention

Do not loosen toothed-gear tensioner (arrow).

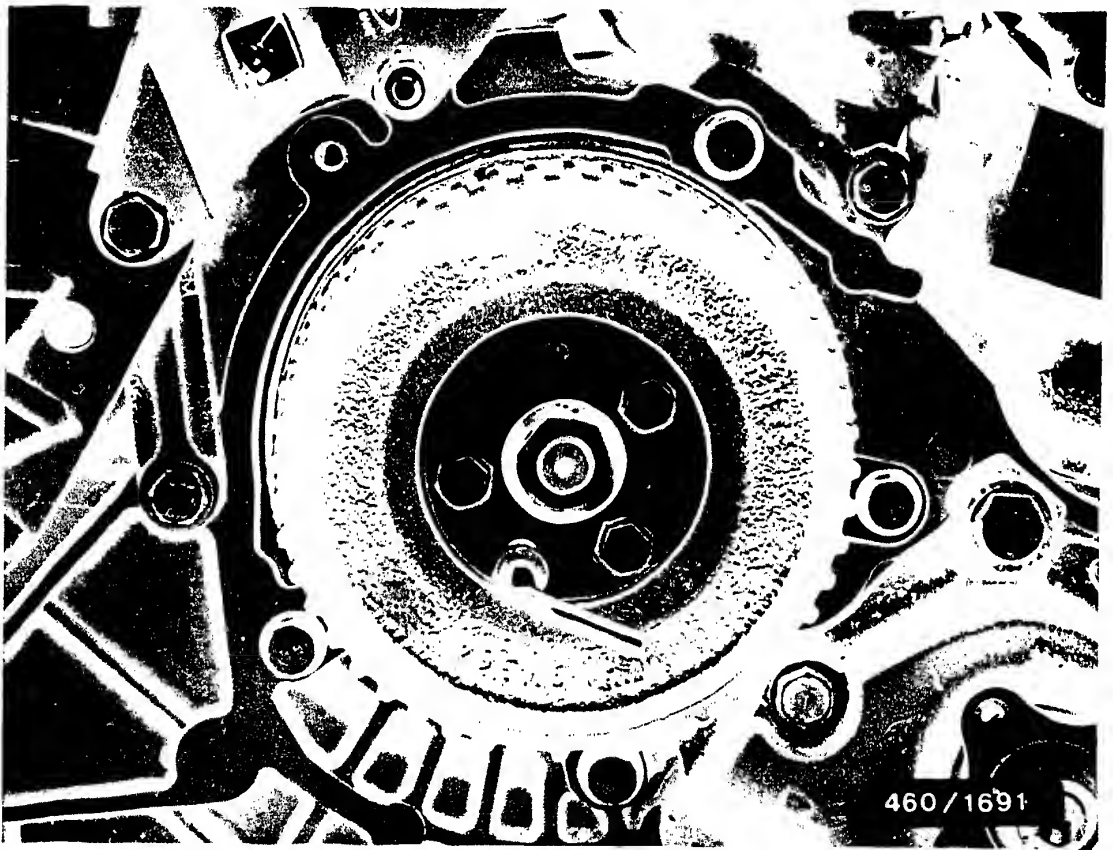


Loosen fastening screws of injection-pump driving gear (arrows).

**F17**

Coord., inj.-pump - engine (inj. timing)  
Ford





Turn injection-pump drive gear until locating pin KDEP 1161/1 may be inserted. Tighten fastening screws to 22 - 27 Nm.

Note:

If drive gear cannot be adjusted by turning, remove toothed belt and adjust injection pump in such a way that the fastening screws are positioned at the center of the slots in the driving gear. Position toothed belt and tighten.



Secure cylindrical-gear cover.

Mount viscous fan onto water-pump shaft.

Pull on V-belt of fan/generator and tighten with fastening screws.

Pull V-belt onto vacuum pump and tighten with V-belt clamping device.

Install radiator.

Mount radiator grid.

**F19**

Coord., inj.-pump - engine (inj. timing)

Ford





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### Coordinates

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Automotive Equipment - After-Sales Service  
Department for Technical Publications KH/VDT,  
Postfach 50, D-7000 Stuttgart 1.

Published by: After-Sales Service Department for  
Training and Technology (KH/VSK). Press date: 1.1987

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Microfilmed in the Federal Republic of Germany.  
Microphotographié en République Fédérale d'Allemagne.

